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ABSTRACT

This final report describes activities and findings of a 3-year federally supported outreach project, which was designed to replicate a developmentally appropriate interactive technology literacy curriculum model into early childhood special education programs serving children (ages 3-6) with mild to moderate disabilities. Major goals focused on linking results of emergent literacy research to early childhood practice; disseminating the project nationwide; and serving as a national resource on emergent literacy and technology. The project model, LitTECH, was replicated in 17 school districts and affected 89 classrooms, 94 teachers, and 3,097 children. Extensive data were collected on 643 children with disabilities, 1,012 children at risk, and 607 children without disabilities. Project findings point to positive benefits for teachers, children, and families and to conditions that promote effective implementation and maintenance of the model. Findings supported use of a variety of effective implementation techniques at the classroom level including using a sign-up sheet, using KidDesk for desktop management, and implementing software curriculum integration into the program curriculum. Following a statement of the project's goals and objectives and theoretical framework, individual sections describe the program, changes, methodology, results, project impact, and future activities. (Contains 42 references.) (DB)

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Final Report: LitTECH Interactive Outreach

by Patricia Hutinger, Carol Bell, Joyce Johanson,
and Kathy McGruder

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Table of Contents

Abstract 4

Goals and Objectives 6

Theoretical Framework 6

  Previous Research Findings Related to Emergent Literacy 8

  Figure 1. Summary of Basic Emergent Literacy Concepts 9

Description 10

  The LitTECH Model 10

    Family Participation 12

  Description of Outreach Model Procedures 12

    Replication 12

  Figure 2. LitTECH Outreach Process 13

    Training content 14

    Follow-up support 14

    Inservice 15

  Continuation and Replication Sites 15

    Continuation sites 15

  Table 1. LitTECH Continuation and Replication Sites 16

    New replication sites 18

  Training Activities 23

    Action Plans 24

    Training evaluations 24

    Follow-up activities 27

Changes 28

  Changes in Enterprise Community Site 28

Findings 29

Method 30

  Participants 30

  Data Sources 32

  Figure 3. LitTECH Instruments, Data Targets, and Data Collection Schedule 32

    Child data sources 32

Teacher data sources 33

Family data sources 35

Data Collection 35

Data Analysis 37

Quantitative data 37

Qualitative data 37

Results and Discussion 39

Findings Related to Children 40

Table 2. Data Sources Indicating Child Behaviors 40

Comparison of children with and without labeled disabilities 41

Table 3. Significant Different in Positive *ILA* Post Test Scores Between Children with and without Disabilities 42

Table 4. Significant Differences in Positive *BIT* Post Test Scores Between Children with and without Disabilities 42

Informal Literacy Assessment (ILA) results 45

Table 5. Year 2 Corresponding t-tests of *ILA* Questions 45

Table 6. Year 3 Corresponding t-tests of *ILA* Questions 47

Behavior Interaction Tool (BIT) results 48

Table 7. Year 2 Corresponding t-tests among *BIT* Questions 49

Kids and Computers results 50

Table 8. Year 3 Corresponding t-test among *BIT* Questions 51

Figure 4. Examples from the *Kids and Computers* Form 53

Patterns of child behavior 53

Teachers' observational reports on LitTECH's impact on children 57

Findings Related to Teachers 61

Action Plans 61

Figure 5. Sample Statements from Teachers' Action Plans for Modules 1 – 4 61

Follow-up Survey 64

Teacher results—Model Fidelity Profile 66

Participant Satisfaction Survey 68

Finding Related to Families 69

- Family participation in LitTECH........ 70
- Implementing the model........ 71
- Table 9. Data Sources Showing Effective Methods Used by Classroom Teachers....... 72
- Teacher skills........ 73

Project Impact........ 74

- Conference Presentations and Publications........ 74
- Products........ 75
  - Curriculum........ 75
  - Video........ 75
  - Web site........ 76

Future Activities........ 78

Assurance Statement........ 80

References........ 81

Abstract

The major purpose of LitTECH Interactive, a 3-year outreach project conducted by The Center for Best Practices in Early Childhood (formerly Macomb Projects) in the College of Education and Human Services at Western Illinois University, was to replicate a developmentally appropriate interactive technology literacy curriculum model into early childhood special education programs serving children age three to six with mild to moderate disabilities. Major goals focused on linking the results of emergent literacy research to early childhood practice; disseminating the project nationwide; and serving as a national resource for products and information related to emergent literacy and technology. Objectives included awareness activities; replication; product development, revision, and dissemination; training, consultation, and assistance to states and communities; and participation in local, regional and national cooperative activities. The LitTECH model was based on a 3-year qualitative research study (Hutinger, et al., 1998) conducted by Macomb Projects.

During the 3-year period, LitTECH was replicated in 17 school districts impacting 89 classrooms, 94 teachers, and 3,097 children. Classrooms included 60 preschools, one kindergarten, 12 first grades, and five second grades, and one third grade. Ten of the 89 classrooms were multi-grade classrooms, and four were first and second grade resource or self-contained classrooms. Extensive child data were collected on 643 children with disabilities, 1,012 children at risk, and 607 children without disabilities.

Project findings point to positive benefits for teachers, children, and families and to conditions that promote effective implementation and maintenance of the innovation. Teachers learned new computer skills and improved the classroom computer environment by changing management of the computer center, implementing a sign-up sheet, including books and other

print materials, and including seating at the computer for at least two children. Children with a variety of disabilities engaged in emergent literacy activities. Children gained emergent literacy skills and improved their understanding of concepts. Communication skills, social interaction, problem solving, and attending skills improved. Families reported participating in emergent literacy activities in the classroom and engaged in literacy activities with their children at home. These findings were similar to those reported in the 3-year literacy research study on which LitTECH was based (Hutinger, et al., 1998).

Findings showed similarities to the original research results concerning effective implementation and maintenance of the project. These included: using a sign-up sheet; using *KidDesk* for desktop management; authoring *HyperStudio* stacks or using similar multi-media software; implementing software curriculum integration activities into the program curriculum; changing the computer environment following LitTECH recommendations; having a variety of software available; making materials for drawing, writing, book making, and reading available throughout the classroom; using environmental print in the classroom; and integrating family activities.

Products resulting from the project include ***eMERGing Literacy and Technology: Working Together***, a 490-page curriculum; two videos: ***Children as Storytellers to the World: HyperStudio, Literacy & the Internet*** and ***LitTECH Interactive Presents: The Beginning of Literacy***; and a web site <http://www.mprojects.wiu.edu/littech/>. National, regional, and state presentations were attended by over 360 early childhood educators, therapists, paraprofessionals, and family members with replication requests coming from some participants.

Final Report: LitTECH Interactive Outreach

by Patricia Hutinger, Carol Bell, Joyce Johanson, and Kate McGruder

The LitTECH Interactive Outreach project was funded by the U.S. Department of Education, Office of Special Education Programs, under the Early Education Program for Children with Disabilities (EEPCD). The 3-year project began its work on October 1, 1997.

Goals and Objectives

LitTECH had three major goals: (1) to link the effective results of the emergent literacy technology model findings to early childhood practice, (2) to disseminate information about the project to early childhood program personnel, families, and decision makers across the United States, thereby increasing and improving emergent literacy practices; and (3) to serve as a national resource for products and information related to emergent literacy and technology in both traditional and innovative modes. The objectives to accomplish the goals included Awareness; Replication; Product Revision, Development, and Dissemination; Training and Consultation; and Cooperation with Other Related Agencies. All objectives included evaluation activities and associated data collection and analysis.

Theoretical Framework

The LitTECH model coupled computer technology with a tested preschool curriculum to produce positive literacy outcomes in preschoolers with disabilities. LitTECH was based on the assumptions that emergent literacy (1) forms the groundwork for attaining adult literacy and (2) is as important for preschool children with disabilities as it is for preschool children without disabilities.

Literacy is more than reciting the alphabet. When preschoolers point to pictures in a book or on a computer screen and pretend to "read" the story; when pseudo-letters, then recognizable letters and words, emerge from scribbles in drawings; or when a 3-year-old recognizes the Hardees' logo on a hot air balloon and asks for french fries, these children demonstrate behaviors associated with the emergence of literacy.

The beginnings of literacy lie in the everyday experiences of early childhood and seem to be crucial to literacy acquisition (Casey, 1997;Mason & Allen, 1986; McGee & Lomax, 1990). Unfortunately, when children have disabilities that make their world different from that of their peers who are not disabled, literacy is not likely to be a part of their early intervention plan nor are their teachers aware of emergent literacy research (Erickson & Koppenhaver, 1995). Neither do these children enjoy a literacy environment at home where stories are read to them (Marvin, 1994). The educational experiences of young children with disabilities tend to focus on gross and fine motor skills, communication, cognition, and self help skills rather than on aspects of emergent literacy.

Concepts related to emergent literacy form the basis for later reading and writing and are widely accepted in programs for young children without disabilities but are rarely evidenced in educational practice for preschool children with special needs. While emergent literacy has been the topic of many research studies in programs for young children without disabilities, it has gained less attention in the special education community.

To demonstrate this point, prior to writing the 1997 proposal for LitTECH Outreach, staff at The Center for Best Practices in Early Childhood conducted a search of ERIC documents and journal articles for emergent literacy titles dating from 1990 to 1997. That search revealed over 150 entries using 'emergent literacy' and 'early childhood' as key words. However, when the search was conducted for 'emergent literacy' and 'special education,' only nine documents were found. A search of 'emergent literacy' and 'special education' plus 'early childhood' resulted in six documents. A review of textbooks used in early childhood special education revealed few index references to 'emergent literacy,' although 'communication' was included in almost all texts.

Previous Research Findings Related to Emergent Literacy

Literacy is a social, psychological, and linguistic process. Emergent literacy emanated from cognitive psychology and psycholinguistics (Gunn, Simmons, & Kameenui, 1995; Hiebert & Papierz, 1990; Katims, 1994; Mason & Allen, 1986; McGee & Lomax, 1990; Sulzby & Teale, 1991). An emergent literacy approach stresses that written and oral language develop concurrently and interrelatedly from birth. Both oral and written language are best learned when used in purposeful contexts and when children have opportunities to observe and interact with others who write and read (Clay, 1975; Harste, Woodward, & Burke, 1984; Sulzby, 1990) as opposed to rote learning of letters, words, or sounds out of context.

Literacy concepts emerge early in life. A summary of basic emergent literacy concepts is shown in Figure 1. Since much of what is known about emergent literacy has been based on research with typically developing children (Cousin, Weekley, & Gerard, 1993), even if teachers of youngsters with disabilities know about emergent literacy practices, they may question use of such practices with their children (Patzer & Pettegrew, 1996). Many children with oral language delays and impairments have significant literacy problems before they are in first grade (Scarborough & Dobrich, 1990). Although some suggest that children with mild to moderate disabilities develop literacy in ways that are quite similar to those of children without disabilities (Brazee & Haynes, 1989; Cutler & Stone,1988; Erickson & Koppenhaver, 1995; Goodman,

Figure 1. Summary of Basic Emergent Literacy Concepts

We use pictures and words to communicate.
Pictures have meaning.
Words have meaning.
Words are used to tell stories.
The words tell about the pictures.
Children can make their own stories using pictures and words.
Stories have a sequence.
Stories have characters, actions, and settings.
Stories have a beginning, middle, and end.
We read words on a page from left to right.
We read from the top of the page to the bottom.
There is a one to one correspondence between written and spoken words.
Each word we say can be written down, using one or more letters of the alphabet.
Written words are separated by spaces, just as spoken words are separated by brief pauses.

1982; Hasselriss, 1982; Katims, 1991; Pierce & Porter, 1996), typically these children do not have the opportunity to do so and as such, are the children who fall behind in kindergarten and the primary grades. Children who fail to "catch on" early keep falling further and further behind and are likely to end up repeating a grade or are assigned to transition classes (Strickland, 1990). As children who are "behind" in reading move into the upper grades, they do not "catch up." Rather they stay "behind" (Clay, 1979). High school graduation is unlikely for readers who are less than modestly skilled at the end of third grade (Snow, Burns, & Griffin, 1998).

The outlook for children with disabilities to experience opportunities to develop literacy is grim. Many teachers do not view children with severe disabilities as capable of learning to read and write and consequently provide them with few opportunities to learn written language (Light & McNaughton, 1993). Koppenhaver and Yoder (1993) point out that even if teachers view the child as capable, that child is more likely to receive word level skill-and-drill activities, seldom reading or listening to text and more rarely, composing text.

Individual Education Plans (IEPs) tend to emphasize fine motor tasks and self-help skills. Erickson and Koppenhaver (1995) found that when IEPs focused on academics, tasks were likely to include name recognition and rote memorization. Longitudinal case studies (Hutinger, Johanson, & Stoneburner, 1996) of fourteen children who demonstrated moderate to severe disabilities support Erickson and Koppenhaver's findings, revealing that those children, in spite of having sporadic access to technology applications as they progressed through school, rarely learned to read nor did their IEPs focus on literacy behaviors. Models of best practice providing strategies in how to provide appropriate literacy instruction to children with disabilities are scarce at best (Erickson & Koppenhaver, 1995).

Description

The LitTECH Model

Research model. The LitTECH model is based on a 3-year qualitative research study[1] (Hutinger, et al, 1998) conducted by Macomb Projects (now The Center for Best Practices in Early Childhood) at Western Illinois University. A theoretical framework of concepts related to the development of reading and writing influenced the processes used to develop LitTECH emergent literacy concepts, incorporating the use of interactive technology. The strategies assisted children to acquire and develop literacy and language productively and appropriately.

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[1] The Early Childhood Emergent Literacy Technology Research Project, PR #H180G40078

The LitTECH model was designed to recognize and appreciate children's home cultures and to build upon the uses of language and literacy through existing home experiences.

The model was carried on in four types of classrooms classified according to the presence or absence of the LitTECH curriculum and the technology experience of the teachers. The teachers were committed to the project and participated to the fullest of their ability. They assisted in planning and implementation, as well as aspects of data collection. Classroom management techniques involved methods to integrate literacy activities during group time and free choice. The management issue was found to be important to the development of emergent literacy components. Placement of the technology center, facilitating children's management of the computer center, and supporting groups of computer users to promote socialization, oral language, and turn taking were critical factors. Careful review of software led to selection of software titles that support both literacy and the classroom curriculum. Software titles chosen for use in LitTECH classrooms were interactive, appealed to a wide range of abilities, nurtured children's learning styles, and supported activities in the reading center, other areas of the classroom, and at home.

Curriculum activities were designed to promote literacy development at the computer center as well as in other areas of the environment and other curricula areas. A description at the beginning of each activity explained the links between the software and children's learning. Three types of software, organized according to levels of interactivity, were used:

(1) interactive literature-based software which could be used to extend literacy concepts and behaviors including the Living Books series such as *Just Grandma and Me*, *Harry and the Haunted House*, and *Stellaluna*;

(2) tool (drawing and writing) software such as *Kid Pix 2*, *EA*Kids Art Center*, and *Stanley's Sticker Stories*; and

(3) *HyperStudio*, an authoring program used by teachers and children to develop their own software based on meaningful experiences such as a favorite story, art work, field trip to the veterinarian's office, or a child's family.

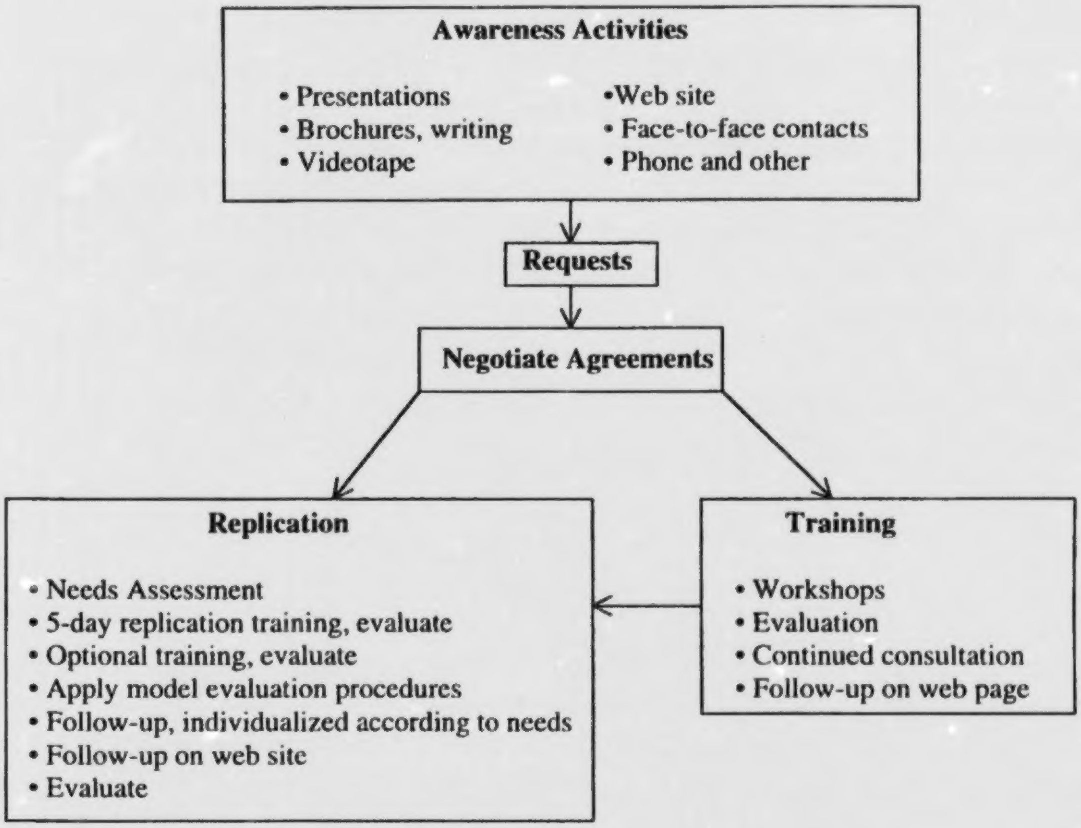
Family participation. Families were supported in LitTECH activities and were offered many ways to participate. Awareness activities were informational. Newsletters and notes were distributed and included topics such as the importance of emergent literacy and activities to try at home. Families participated in Family Night literacy sessions hosted by the teachers and in classroom activities, observing or working with the children. They often left E-mail and voice mail messages on *KidDesk* for their child. They also participated in evaluation activities.

Description of Outreach Model Procedures

Figure 2 shows the Outreach process based on initial face-to-face learning with individualized follow-up services, a concept supported by Huberman (1990). Replication decisions were based on issues of accessibility, costs, history of practical use, convenience, and accessible electronic communication. Awareness activities were designed to acquaint the target audience with LitTECH services and to recruit replication site participants.

Replication. Sites first signed a replication agreement detailing their responsibilities and LitTECH's responsibility. Prior to site training, personnel completed a Participant Profile and Needs Assessment designed to determine learning needs. Training began with a 4-day workshop, which could be split into two 1-day workshops and one 2-day workshop; four 1-day workshops; or two 2-day workshops. If participants lived within driving distance of Macomb, a 12-week session was an option, meeting 3 hours per week. LitTECH training could be taken for two or three semester hours of graduate credit from Western Illinois University (WIU). Training procedures were based on principles of adult learning (Knowles, 1978; Knowles, Holton, & Swanson, 1998; Krupp, 1989).

Figure 2. LitTECH Outreach Process


Awareness Activities
• Presentations
• Brochures, writing
• Videotape
•Web site
• Face-to-face contacts
• Phone and other
Requests
Negotiate Agreements
Replication
• Needs Assessment
• 5-day replication training, evaluate
• Optional training, evaluate
• Apply model evaluation procedures
• Follow-up, individualized according to needs
• Follow-up on web site
• Evaluate
Training
• Workshops
• Evaluation
• Continued consultation
• Follow-up on web page

Site personnel planned and implemented various emergent literacy technology experiences. Strategies to incorporate adaptations and ethnic and cultural traditions were also implemented. As the implementation progressed, learners evaluated their conceptual and skill attainment, their use of LitTECH with children, and the nature of their interactions with project staff, and discussed effective and ineffective implementation experiences. After a site began replication, LitTECH provided support at varying levels, depending on needs, for at least 2 years. The degree to which the site replicated the model was determined by the Model Fidelity Profile (see page 34 for a description).

Training content. Learners engaged in five learning modules:

(1) *Building a Firm Foundation for Emerging Literacy;*

(2) *The LitTECH Computer Environment*;

(3) *Using Children's Software to Support Literacy Behaviors*;

(4) *Using HyperStudio to Enrich the Emerging Literacy Curriculum*; and

(5) *Using Adult Applications to Support LitTECH.*

Module content was related to emergent literacy, computer technology, software characteristics, interactivity level of software, integrating literacy activities into the curriculum, and adult productivity applications. Each module included sections titled *Learning Content, Learner Objectives,* and *Materials and Handouts*. The modules included measures to evaluate literacy and related content. Participant learning materials were based on instructional design principles formulated by R.M. Gagné (1985) and Smith and Ragan (1993). Technology and literacy-related products available from the Center were used to support LitTECH training.

Follow-up support. Follow-up support included additional 1-3 day workshops that were offered on the WIU campus or were arranged on site with sites supporting travel expenses. Follow-up support was provided electronically via the project web site <http://www.mprojects.wiu.edu/littech/>, which included a FAQ (Frequently Asked Questions) section and E-mail. Through these communication media, sites could access LitTECH staff and each other. Sites used the project fax or toll free phone number to access project staff for individual follow-up and feedback via electronic or regular mail.

Inservice. LitTECH also conducted workshops on topics requested by families, personnel from schools, family centers, and community resources (e.g., libraries, YMCAs). Topics such as *Emerging Literacy Elements, Software Integration, HyperStudio Applications, Word Processing*, and *Web Site Activities* were offered.

Continuation and Replication Sites

During the reporting period, LitTECH was replicated in 17 school districts representing 89 classrooms, 94 teachers, and 3,097 children. Classrooms included 60 preschool classrooms, one kindergarten, 12 first grades, five second grades, and one third grade. Ten more classrooms were cross-grade classrooms and four classrooms were first and second grade resource or self-contained classrooms. Table 1 provides information about the 20 continuation and replication sites involved in the 3-year LitTECH project. Descriptions of each site follow the Table.

Continuation sites. LitTECH's Continuation Sites were originally established between October 1, 1994 and September 30, 1997 as part of the original research project on which the LitTECH model is based. Information about those five sites follows.

- Industry Early Childhood Program, CUSD #165, Industry, Illinois, had both morning and afternoon classes that met 4 days a week for 2 1/2 hours each day. One classroom teacher and one program assistant in this inclusion classroom served children at-risk and children with mild disabilities. An individual aide was provided as needed. The school provided speech/language, occupational, and physical therapies as needed. The number of children served in this classroom in 1997/98 was 25 (10 children with disabilities). In 1998/99, twenty-five children were served, including 10 children with disabilities. Eighteen children, including 8 with disabilities, were served in 1999/00.

Table 1. LitTECH Continuation and Replication Sites Participating in Project Activities, October 1, 1997 - September 30, 2000

	Number of Classrooms	Type of Classroom	Number Of Teachers	Total Number of Children Served	Number of Children Served			Number of Children With Disabilities		
					Yr 1	Yr 2	Yr 3	Yr 1	Yr 2	Yr 3
Continuation Sites Established 1994-1997										
CUSD #165 Industry, IL	1	Inclusion	1	68	25	25	18	10	10	8
CUSD #176 Avon, IL	1	Inclusion	1	49	27	22	-	10	7	-
UD #117 Jacksonville, IL	1	ECE	1	48	14	16	18	14	16	18
UD #180 Colchester, IL	1	ECE	1	46	17	17	12	17	17	12
Replication Sites Established 1997-2000										
SD #66, Canton, IL	1	ECE	1	59	20	20	19	20	20	19
CUSD #185, Macomb, IL	5	ECE/ At-Risk	5	182	-	84	98	-	29	38
Four Rivers Special Education District Jacksonville, IL	10	ECE	10	125	-	-	125	-	-	125
CUSD #176, Avon, IL	1	1st	1	43	-	21	22	-	8	4
CUSD #5, Sterling, IL	4	At-Risk	4	160	-	-	160	-	-	-
CUSD #100, Jerseyville, IL	5	At-Risk	5	320	-	160	160	-	25	10
UD #172, Quincy, IL	7	ECE/ At-Risk	7	336	-	142	194	-	54	56
UD #61, Decatur, IL	5	ECE	8	112	-	-	112	-	-	112
CUSD #213, Athens, IL	3	At-Risk	3	74	-	-	74	-	-	-
CUSD #5, Chatham, IL	5	At-Risk	5	103	-	-	103	-	-	9
UD #150, Peoria, IL	9	ECE-2nd	9	261	-	-	261	-	-	34
SD #186, Springfield, IL	5	At-Risk	5	180	-	180	-	-	39	-
CUSD #13, East Alton, IL	4	ECE/ At-Risk	4	213	-	108	105	-	20	20
CUSD #430, Sandwich, IL	7	PreK-1st G	9	393	-	180	213	-	20	20
CUSD #185, Macomb, IL	14	Kdg, CCI, resource and1st-3rd	14	325	-	101	224	-	39	63
Total	**89**		**94**	**3097**	**103**	**1076**	**1918**	**71**	**304**	**548**

- Avon Early Childhood Program, CUSD #176, Avon, Illinois, had both morning and afternoon classes that met 5 days a week for 2 1/2 hours each day. One classroom teacher and one program assistant in this inclusion classroom served children at-risk and children with mild and moderate disabilities. An individual aide was provided as needed. The school provided speech/language, occupational, and physical therapies as needed. Twenty seven children were served by this program in 1997/98. Ten of the children had disabilities. In 1998/99, 22 children were served, including seven children with disabilities. In the fall of 1999, the teacher who was originally trained in the model left to accept a teaching position in Canton, Illinois. The new early childhood teacher was invited to participate in LitTECH activities and offered training, but she did not accept an invitation to replicate until the end of the funding period. Therefore, LitTECH did not count this program as a site during the project's third year. Technology was not available to the teacher who moved to Canton, so she and the children in her new classroom were unable to participate in the project.
- Lafayette Center Early Childhood Program, Four Rivers Special Education Co-op, UD #117, Jacksonville, Illinois, had both morning and afternoon classes that met 5 days a week for 2 1/2 hours each day. One classroom teacher and one program assistant served children with moderate to severe disabilities. Individual aides were provided if needed. The program provided nurses, speech/language, occupational, and physical therapies. Fourteen children with disabilities were served by the program in 1997/98. In 1998/99, 16 children with disabilities were served. Eighteen children with disabilities were served in 1999/00.
- Colchester Early Childhood Program, UD #180, Colchester, Illinois, had both morning and afternoon classes that met 5 days a week for 2 1/2 hours each day. The program was an early childhood special education program serving children with mild to moderate disabilities.

There was one classroom teacher and one program assistant. Individual aides were provided if they were needed. The school provided speech/language, occupational, and physical therapies on an as needed basis. Seventeen children with disabilities were served by the program in 1997/98 and 1998/99. Twelve children with disabilities were served in 1999/00.

New replication sites. During the period from October 1, 1997 and September 30, 2000, 90 teachers from 15 sites were trained to replicate the LitTECH model. Information about each site follows.

- Westview Elementary, SD #66, Canton, Illinois, was the first LitTECH replication site. The program had both morning and afternoon classes that met 5 days a week for 2 1/2 hours each day. The program was an early childhood special education program that served children with mild to moderate disabilities. There was one classroom teacher and one program assistant. Individual aides were provided as needed. The school provided speech/language, occupational, and physical therapies as needed. Twenty children with disabilities were served by the program in 1997/98 and 1998/99. Nineteen children with disabilities were served in 1999/00.
- Macomb Early Childhood Program, CUSD #185, Macomb, Illinois, houses an early childhood program serving early childhood special education including children with mild to moderate disabilities and pre-k at-risk. The center operated full day, inclusive classrooms, and classrooms that met 4 days a week for 2 1/2 hours each day. Five classroom teachers participated in the project. Two of the classroom teachers served children with disabilities and three teachers served children at risk. Each classroom had one classroom teacher and one program assistant. A one-on-one aide was provided in classrooms when needed. A state-funded parent program serving the district was housed in the building. The school provided

speech/language, occupational, and physical therapies as needed. Eighty-four children were served in 1998/99, including 29 children with disabilities. In 1999/00, 98 children, including 38 with disabilities, were served.

- Four Rivers Special Education District was a special education district in Illinois encompassing Beardstown, Pittsfield, Roodhouse, Franklin, Hardin, Jacksonville, Versailles, and Whitehall. The program served children with mild to severe disabilities, including medically fragile children. The district had 10 early childhood special education teachers with a program assistant in each classroom. The programs had both morning and afternoon classes that met 5 days a week for 2 1/2 hours each day. A one-on-one aide was provided as needed. The school provided speech/language, occupational, and physical therapies as needed. LitTECH was replicated in 10 classrooms. The number of children with disabilities in 1999/00 was 143.
- Avon Grade School, CUSD #176, Avon, Illinois, started replicating the model in the spring of 1999. One first grade teacher participated. There were no program aides. The program met for a full day, 5 days a week. The school provided speech/language, occupational, and physical therapies as needed. Twenty-one children were served in 1998/99. Eight children had disabilities. Twenty-two children, including 4 with disabilities, were served in 1999/00.
- Sterling Early Childhood Center, CUSD #5, Sterling, Illinois, was a pre-k at-risk program housed in three communities: Sterling, Dixon, and Rock Falls. Four teachers participated in the replication project. Each classroom had a program aide. The program provided a parent coordinator housed at Wallace, a bilingual assistant, and a home base teacher. The number of children served by the four teachers in 1999/00 was 160.

- Jersey Early Childhood Program, CUSD #100, Jerseyville, Illinois, replicated the project in five classrooms in late spring of 1998. Jersey was housed in two communities, one in Jerseyville and one in Grafton. The program was a pre-k at-risk program with morning and afternoon classes that met 4 days a week for 2 1/2 hours each day. The five classroom teachers each had one program assistant. Individual aides were provided as needed. The program provided a speech/language pathologist and assistant. Occupational and physical therapies were provided as needed. In 1998/99, 160 children were served, including 25 with disabilities. In 1999/00, ten of the 160 children served had disabilities.
- Quincy Early Childhood and Family Program, UD #172 Quincy, Illinois, was housed in two buildings, the Quincy Early Childhood Family Center and the Early Childhood Center. The program provided services to early childhood special education, pre-k at-risk, and Head Start, as well as family services to families with children ages 0–5. The program had both morning and afternoon classes that met 5 days a week for 2 1/2 hours each day. Seven teachers and their program assistants replicated the model. The disability coordinator, family involvement coordinator, curriculum coordinator, and family educator provided support for the model. Each classroom had one teacher and one assistant. Individual aides were provided as needed. The program provided speech/language, occupational, and physical therapies. One hundred forty-two children were served in 1997/98, including 54 children with disabilities. In 1999/00, 194 children, including 56 children with disabilities, were served.
- Sunnyside Special Education Program, UD #61, Decatur, Illinois, was a special education program serving children with mild to severe disabilities. Eight teachers replicated the model. Two speech and language pathologists and an occupational therapist provided support. Each classroom had one teacher and one assistant. The program had both morning and afternoon

classes that met 5 days a week for 2 1/2 hours each day. Individual assistants were provided as needed. The school provided speech/language, occupational, and physical therapies as needed. The number of children with disabilities served in 1999/00 was 112.

- Athens Early Childhood Program, CUSD #213, Cantrall, Illinois, was a pre-k at-risk program that met 5 days a week for 2 1/2 hours each day. Three classrooms replicated the model. One teacher and one aide were located in each classroom. A family educator provided support. The school provided speech/language, occupational, and physical therapies as needed. Seventy-four children were served in 1999/00.
- Chatham Early Childhood Program, CUSD #5, Chatham, Illinois, began replicating the model in the spring of 1999. The program had five teachers and was an inclusive pre-k program housed in two locations, Ball Elementary in Chatham and LLDC in Springfield. Four classrooms had both morning and afternoon classes that met 4 days a week for 2 1/2 hours each day. One classroom was a 1/2-day program, which met 2 1/2 hours each day 4 days a week. A program assistant was provided in each classroom. The number of children served in 1999/00 was 103 (9 with disabilities).
- Valeska Hinton Early Childhood Program, UD #150, Peoria, Illinois, was an early childhood program housing preschool early childhood special education through second grade. A model program in the Peoria School District, the program housed mixed-age classrooms (preschool and kindergarten, first grade and second grade) and provided family support for all parents. The program had full-day classes that met 5 days a week. Nine teachers and their program assistants replicated the model. The reading specialist/curriculum coordinator and the family coordinator provided support for the model. Each classroom had one teacher and one assistant. Individual assistants were provided as needed. The program provided

speech/language, occupational, and physical therapies. In 1999/00, 261 children were served, including 34 children with disabilities.

- Withrow Early Childhood Program, SD #186, Springfield, Illinois, became a LitTECH Replication site in the spring of 1998. It had both morning and afternoon classes that met 5 days a week for 2 1/2 hours each day. The program served pre-k at-risk and early childhood special education. The program housed 23 early childhood classrooms serving 740 children; 22% of the children served received special education services. Five teachers and one speech and language pathologist replicated the model. The school provided speech/language, occupational, and physical therapies as needed. In 1998/99, 180 children were served, including 39 children with disabilities.
- Lincoln Early Childhood Program, CUSD #13, East Alton, Illinois, began replicating the model in the spring of 1998. The program was an inclusive pre-k and early childhood special education program with four teachers and was housed in an early childhood building in East Alton, Illinois. The pre-k classrooms had both morning and afternoon classes that met 4 days a week, 2 1/2 hours each day. The special education program had both morning and afternoon classes that met 5 days a week for 2 1/2 hours each day. A program assistant was provided in each classroom. Individual aides were provided as needed. The school provided speech/language, occupational, and physical therapies as needed. One hundred eight children were served in 1998/99. Twenty had disabilities. In 1999/00, 105 children, including 20 with disabilities, were served.
- Sandwich Early Childhood Program, CUSD #430, Sandwich, Illinois, began replicating the model in the fall of 1998. The model was replicated in a pre-k classroom, two kindergarten classrooms, and five first grade classrooms. One resource teacher also participated. The pre-k

program included one teacher, one assistant, and one bilingual assistant. Children in the program were divided into three groups. Group A and B met 3 days a week for 2 1/2 hours each day. Group B met 2 days a week for 2 1/2 hours each day. The kindergarten was housed in the same facility as the pre-k program. The kindergarten met 5 days a week for 2 1/2 hours each day. The four first grade programs met 5 days a week for a full day. Individual aides were provided as needed. The school provided speech/language, occupational, and physical therapies as needed. In 1998/99, 180 children were served, including 20 with disabilities. In 1999/00, 213 children were served, including 20 with disabilities.

- Lincoln Elementary, CUSD #185, Macomb, Illinois, an attendance center housing kindergarten, first, second, and third grades, began replicating the model in the spring of 1999. Teachers from one kindergarten, one self-contained kindergarten and first grade CCI, one first grade resource, three first grade, five second grade, one second and third grade CCI, one second grade resource, and one third grade participated in the model. All classrooms were full-day programs with the exception of resource, where children received services during parts of the day. Each classroom had one teacher. Program assistants and personal aides were assigned as needed. The school provided speech/language, occupational, and physical therapies as needed. In 1998/99, 101 children were served; 39 had disabilities. In 1999/00, 224 children, including 63 with disabilities, were served.

Training Activities

Training events were offered on campus at Western Illinois University or at a site selected by the replicating agency. All replicating agencies except Avon and Macomb received training at schools located near their area. Project staff conducted 90 replication training events.

After a site began replication, LitTECH provided support, at varying levels depending on needs. Follow-up on-site workshops were provided to five sites. Two sites received additional 3-day workshops on the WIU campus. Three sites arranged 1–3 days of additional follow-up at their own location. Follow-up support was also provided electronically via the project's web site with a bulletin board, FAQ (Frequently Asked Questions) section, and E-mail. Through these communication media, sites could access the Outreach staff and each other. Sites used a toll-free phone to access project staff for individual follow-up and feedback via electronic or regular mail. Project staff provided 549 consultations via E-mail, phone, and the listserv. The majority of requests concerned *training* (276), followed by *technical assistance* (108), *follow-up* (92), and *further information* (73).

Action Plans. An important aspect of each LitTECH Module was the Action Plan. Each participant filled out a triplicate form with a description of the activity she planned to do based on the content of the Module. Each set a target date for completion and described how she would disseminate the results of her plan to the other participants and the LitTECH staff. Demonstration could be one or a combination of (1) photographs, (2) child-produced samples and activities, (3) videotape, or (4) another suitable format. Part of the training evaluations (see the section which follows) asked teachers to explain how they would use the information in their classrooms. The completed Action Plans documented how teachers put into practice the things they learned from each Module.

Training evaluations. All training packets included evaluations which were collected at the completion of each Module. Of the 94 teachers trained in the LitTECH model, 78 teachers (83%) completed workshop evaluations at the end of Modules 1 and 2 (Building a Firm Foundation for Literacy and The Computer Environment). All 78 indicated (1) the purpose of the training was accomplished, (2) the training was informative, and (3) the information would be useful to their work. The following comments were representative of responses participants gave when they were asked which activities were the most interesting or beneficial to them.

- *"Designing computer environment and ways to help children become more independent with technology."*
- *"The presenters were excellent in their knowledge of computers and excellent in their skills at working with young children."*
- *"Hands on [was] great. Many, many informative and useful ideas."*
- *"Everything. Actually working on the computers was helpful."*

When participants were asked to respond to how the information provided would be used in the classroom, responses included:

- *"Will use information about where to set up classroom computers."*
- *"Will set up a curriculum to support my program using much more technology."*
- *"Increase literacy for children."*
- *"KidDesk and buying new software that's good for the children. I'm going to try it!"*
- *"Implementing KidDesk into our classroom for every day use."*

As training progressed, the number of evaluations submitted decreased, perhaps because the material in Modules 3 and 4 was more intense and took greater time for teachers to assimilate. Participants working on the in-depth Modules often did not take time to submit their evaluations. They did, however, submit Action Plans for each Module.

Sixty-three percent (69%) of the teachers (n=59) completed workshop evaluations for Module 3 (Using Children's Software to Support Emerging Literacy Behaviors). All of these teachers indicated that the purpose of the workshop was accomplished and the topic was informative. Again, all participants replied that the information presented would be useful to their work.

Teachers were asked which ideas from Module 3 were most interesting or beneficial. The following comments were representative of responses.

- *"Software criteria sheets, sheet with software names and prices, suggested software list. All were very helpful."*
- *"This training will let me incorporate the computer into my classroom in ways I never thought I could. I feel it was very beneficial."*
- *"Evaluating software."*
- *"An entire integrated unit can blossom from a software item, or can be supplemented by one!"*

When participants were asked how the information provided would be used in the classroom, responses included:

- *"Make computer use a natural, ongoing, integrated part of the class day."*
- *"Use the computer in combination with other class activities, not as a separate activity."*
- *"Use programs that are more suitable to child's ability and the unit being covered."*

Seventeen percent (17%) of the teachers (n=16) completed workshop evaluations for Module 4 (Using *HyperStudio* to Enrich the Emerging Literacy Curriculum). All participants found the purpose of the workshop was accomplished and the topic was informative. One hundred percent found the information presented useful to their work. The following comments were representative of responses participants gave when asked which ideas from Module 4 were most interesting or beneficial.

- *"Hands on. I appreciated the way our trainers asked us to think about what we were doing."*

- *"Hands on/Good learning experience having lots of time to work together and individually on the computer."*

Teachers indicated that they would use the information in their classrooms. Representative responses included:

- *"To involve the children more with the computer in the curriculum and bring it more to life in the classroom."*
- *"To customize and enhance interest in the computer."*

Teachers' Action Plans demonstrated that they used their new knowledge to select appropriate software for their classrooms. They integrated the software into their curricula and used it to support or introduce concepts.

Nine percent (9%) of the teachers (n=8) did not fill out individual evaluations, but did evaluate all four of the workshops together. One hundred percent reported that each module's (1-4) purpose was accomplished. All found the information was useful. Additional comments reported by the teachers included:

- *"I learned more from this workshop than in most college semester classes!!! You are wonderful teachers! Tell me of updates on the workshops."*
- *"Staff was excellent! I was allowed to observe, try, and question in whatever order I felt comfortable with, which resulted in more learning than I have ever gotten in other training sessions."*
- *"This was great. The information was very useful. The opportunities to contact the presenters at later dates with more questions will be incredibly helpful."*

Follow-up activities. Follow-up was provided as a result of the Action Plans project staff kept on file from each workshop. The Action Plans were printed on triplicate paper, and participants were given the bottom copy. When a participant did not meet her targeted deadline for submitting the results of her Action Plan, LitTECH staff mailed her the second copy as a reminder. After 30 days, LitTECH staff contacted participants by telephone to discuss follow-through on the Action Plan and to determine if the teacher needed more training or support to complete the activities outlined in the Action Plan. Products derived from Action Plans were used as examples in *eMERGing Literacy and Technology: Working Together*, training videotapes, and conference presentations.

Changes

Changes in Enterprise Community Site

LitTECH was funded with a competitive priority that involved serving Empowerment Zones and/or Enterprise Communities. The targeted Enterprise Community for LitTECH involvement was Springfield, Illinois. Adele Schafer, Deputy Director of the Office of Economic Development and Enterprise Community Coordinator, wrote, "We consider it especially worthwhile that the individual needs of young children with disabilities can be met through the use of assistive technology and welcome Macomb Projects' involvement in our Enterprise Community."

Outreach workshops and follow-up occurred in March and April 1998 in Springfield. The administrator supported her teachers' involvement in the project, and five teachers and one Speech and Language Therapist attended the workshops. Some activities were implemented during the remainder of the school year. In the fall, the school administration changed. The new administrator did not support teachers' involvement in training and implementing the model. Two teachers who received training in the spring were no longer with the school district. One of the three remaining teachers continued to replicate and submit materials documenting replication. The other two teachers submitted some, but not all, required materials. The Speech and Language therapist discontinued her involvement due to personal and health reasons. Another administrative change occurred. This new administrator indicated no interest in supporting teachers' involvement in LitTECH. At that time, project staff decided to focus training efforts on programs whose administrators were excited and supportive of the project's goals.

Findings

The major findings of LitTECH outreach replication and model continuation point to positive literacy and related outcomes for young children with disabilities and those at risk, to teachers' increased ability to incorporate technology and literacy skills, to increased technology integration into classroom curriculum, to adoption of procedures that promote implementation and maintenance of the model, and to families' perceptions of usefulness of LitTECH in their children's education. Data from LitTECH Outreach suggests that the model is not only effective when Center staff are responsible for carrying out model procedures in classrooms, but also retains effectiveness when procedures are used by teachers in replication sites. While findings tend to echo those of a 3-year qualitative research study[2] (Hutinger, et al., 1998), further comparisons of data are planned. Replication procedures, conditions, and effects are currently undergoing study in a 3-year Steppingstones of Technology Research on Implementation project[3].

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[2] The Early Childhood Emergent Literacy Technology Research Project, PR #H180G40078

[3] Disseminating and Replicating an Effective Emerging Literacy Technology Curriculum, PR #H327A000036

Method

Participants

Sites, classrooms, teachers, and children who participated in continuation and replication of LitTECH are described on pages 15 to 23. Three sets of totals are reported. The first set accounts for impact, the second set is made up teachers who reported qualitative and quantitative data, while the third set refers to the number of children on whom quantitative data were collected. Because all children in a classroom participated in technology activities, the total number reported on project *impact* include all who participated from the time when teachers were first trained until the end of the project. This includes *all* teachers, therapists, assistants, (N=130) and 3,097 children and their families.

The number of teachers (N=55) who reported data for children, classrooms, and families account for the *second* set of figures, although more teachers and therapists (N=130) were trained than the number who reported data. A single classroom might house teachers, assistants, and therapists. If a classroom had more than one teacher, the lead teacher reported data for the classroom, children, and families. Teacher, family, and child data were collected for the year directly following the outreach training. Qualitative data was collected from all children in a classroom.

Quantitative data on samples of classroom children, collected on the Informal Literacy Assessment (ILA) and the Behavior Interaction Tool (BIT), represent the third set of figures. Early Childhood Special Education teachers were asked to report BIT and ILA data on a sample of ten children in a classroom. Teachers in inclusive classrooms housing more than 10 children were asked to choose a minimum of five children with disabilities and an additional five at risk or without disabilities on whom to collect and report data. Teachers with fewer than 10 children in their classroom were asked to collect data on all children.

Year 2 pre- and posttest *ILA* data were compiled from 33 children in four Early Childhood/Special Education classrooms, 65 children in seven pre-kindergarten classrooms, 28 children in two inclusive classrooms, 16 children from two pre-kindergarten/kindergarten classrooms, 43 children from five first grade classrooms, 9 children from a second grade classroom, and 10 children from a third grade classroom. Pre- and posttest *ILA* Year 3 data were compiled from 32 children in four Early Childhood/Special Education classrooms, 41 children from five pre-kindergarten classrooms, and six children in one kindergarten/first grade classroom. Of the 204 children tested with the *ILA* in Year 2, 45 (22%) were categorized as children with disabilities. Of the 79 tested with the *ILA* in Year 3, 50 (63%) were categorized as children with disabilities. In Years 2 and 3, 65 children in kindergarten, first, second, and third grade were neither at risk nor identified as having disabilities.

In Year 2, pre- and posttest *BIT* data were compiled from 33 children in four Early Childhood/Special Education classrooms, 72 children in eight pre-kindergarten classrooms, 16 children in one inclusive classroom, 16 children in two pre-kindergarten/kindergarten classrooms, 12 children in two kindergarten/first grade classrooms, 44 children in five first grade classrooms, 20 children from two second grade classrooms, and 10 children from one third grade classroom. In Year 3, pre- and posttest *BIT* data were compiled from 42 children from five Early Childhood/Special Education classrooms, 40 children from five pre-kindergarten classrooms, and six children from one kindergarten/first grade classroom. Out of the 223 children tested with the *BIT* in Year 2, 45 (20%) were categorized as children with disabilities. Out of the 88 children tested with the *BIT* in Year 3, 40 (45%) were categorized as children with disabilities. Nine children in two classrooms repeated both *ILA* and *BIT* testing in Year 2 and Year 3.

Data Sources

The lead teachers in each participating classroom collected qualitative and quantitative data on children, teachers, and families. Measures used from the three data sources are shown in Figure 3 and discussed in the sections which follow.

Figure 3. LitTECH Instruments, Data Targets, and Data Collection Schedule

Instruments Used	Data Target	Schedule
Behavior Interaction Tool (BIT)	Child	Pre and Post – Years 2 and 3
Informal Literacy Assessment (ILA)	Child	Pre and Post – Years 2 and 3
Teacher Observation Report	Child	Three times each year Years 2 and 3
Kids and Computers Form	Child	End of Years 2 and 3
Participant Action Plan Reports	Teacher	Determined by the individual – Years 1 - 3
Follow-up Survey (post—Participant Profile/Needs Assessment)	Teacher/Staff	End of Years 2 and 3
Participant Satisfaction Survey	Teacher	End of Years 2 and 3
Model Fidelity Profile	Teacher	End of Years 2 and 3
Family Questionnaire	Family	Beginning of Years 1 and 2
Family Satisfaction and Follow-up Survey	Family	End of Years 2 and 3

Child data sources. Two quantitative measures, the *Informal Literacy Assessment* (*ILA*) and the *Behavior Interaction Tool*, (*BIT*) were administered. Qualitative measures included teacher reports on observations in the classroom and the *Kids and Computers Form.*

The *ILA*, developed for use in the original literacy research study (Hutinger, et al., 1998), used elements of existing preschool literacy measures by Dyson (1982), Katims (1991), Strickland (1990), Sulzby (1986, 1988), Teale and Sulzby (1986), and Toomey (1991). Items include four major factors: *Book Handling, Pictures, Text,* and *Story.* Administration of the *ILA* was carried out in the classroom during center time so children's literacy behaviors could be observed within the context of the daily environment.

The *BIT* (Hutinger, Harshbarger, and Struck, 1983) has been used in Center research since 1983. It was developed to collect data on children engaged in computer activities. The *Universal BIT*, a 1998 revision of the original, contains subtests, determined by factor analysis, that include *Attending, Cause and Effect, Independence, Planning, Calling Attention to Self in a Positive Way,* and *Peer Interaction.*

Teachers reported their observations of LitTECH's impact on children. Informal observation report forms were mailed to teachers three times a year. The forms requested a weekly written description of observations covering a 1-month period. Project staff asked teachers to observe children's literacy behaviors at the computer as well as social interaction and communication. Teachers returned their observations by mail or E-mail. Teacher's classroom observations provided information about the literacy behaviors children gained during participation in LitTECH.

The words "What I Liked Best About the Computer..." were printed across the top of the *Kids and Computers* form. The remainder of the space was blank. Teachers could opt to have children complete the forms in the classroom or send them home for families to assist in completion. Crayons were attached to the paper. Children completed the topic sentence by drawing, writing, dictating responses to an adult, or using a combination of methods. Seven hundred sixty-seven forms were completed during the 2 years of data collection.

Teacher data sources. Data collected from teachers regarded integrating module content into the curriculum, implementing the LitTECH model, and accessibility of project staff via phone or Internet. Instruments used included *Action Plans, Observation Reports*, a *Follow-up Survey*, the *Model Fidelity Profile*, and the *Participant Satisfaction Survey.*

Teachers' *Action Plans* consisted of specific model implementation strategies mapped out by each participant at the end of training on each module. Using triplicate paper, teachers made written plans to integrate the module content into their existing curriculum and gave a timeline for completion. Plans allowed a reasonable time for implementation. After making a plan, the teacher chose a method to report the plan to project staff (e.g., through photographs and/or slides; videotape; oral discussion of what was tried and how the children responded; materials created for display; samples created by children during curriculum activities). *Action Plans* were collected from all teachers who received training. Each participant kept a copy of her plan. If a report on the *Action Plan* strategy was not sent to project staff by the date designated on a teacher's plan, the second copy was mailed to her as a reminder.

The *Follow-Up Survey* assessed LitTECH model implementation in classrooms. Components of the assessment included: facilitating children's computer use; recommending software; problem-solving strategies; using peripheral devices; communicating with families; developing literacy behaviors; and changing the classroom environment. The survey was administered to site teachers at the end of Years 2 and 3.

The *Model Fidelity Profile*, a self-evaluation instrument, was used to assess the use of the LitTECH model in the classroom. The checklist was divided into four sub-sections. These sub-sections requested information on the set-up of the classroom (*Facilities*), family participation in the project (*Family Involvement)*, the specific materials and equipment used in the classroom (*Materials and Equipment*) and how the LitTECH Curriculum was implemented in the classroom (*LitTECH Curriculum Implementation*). The Profile was administered at the ends of Years 2 and 3.

The *Participant Satisfaction Survey* assessed the accessibility of LitTECH staff for technical support through telephone assistance and the Internet. Components of the survey, administered at the ends of Years 2 and 3, included teacher's comfort level in using the computer, a *Toll-Free Phone Evaluation* and an *Internet Evaluation*. The *Toll-Free Phone Evaluation* assessed the availability and quality of assistance LitTECH staff provided to the teachers when they called regarding technical and/or project questions. The *Internet evaluation* was designed to allow teachers the opportunity to evaluate the project's web site and its usefulness to participants as they implemented the LitTECH model.

Family data sources. A *Family Satisfaction/Follow-up Survey* was designed to evaluate family activity and perception of LitTECH on children and family participants. Items asked families to report how or if they received LitTECH information; knowledge gained as a result of that information; their amount of involvement in LitTECH activities; and their perceived benefit from LitTECH involvement. The *Survey* also asked questions about changes related to technology and literacy that occurred at home as a result of the project. Families completed the *Family Satisfaction/Follow-up Survey* at the end of Years 2 and 3.

Data Collection

Lead teachers (N=55) in the replication classrooms collected qualitative and quantitative data from children, teachers, and families. Data collection followed the schedule shown in Figure 3 on page 32. Figure 3 also lists the instruments and the data targets.

During outreach training, samples of measures and protocols, together with timelines for data collection were included in training materials. Trainees received instructions regarding the kinds of data collection required. Each classroom designated a lead teacher responsible for all data collection from children and families as well as her own evaluation measures and reports.

Evaluation measures and materials, with reminders and descriptive paragraphs on data collection protocols, were mailed to teachers prior to the appropriate date for collection. A return envelope was included with a deadline for the return of the materials. Names of teachers who responded with the necessary data were entered into a drawing for free software.

Forty teachers were trained in Year 1, 48 in Year 2, and 4 in Year 3. Two teachers from continuation sites did not require further training. Because Year 1 was designed to implement LitTECH training and establish the model in classrooms, teachers trained in Year 1 were not asked to collect child data during that year. Data collection and analysis of their classroom data began in Year 2. Teachers first trained in Year 2 then collected data in Year 3 (their second year in LitTECH). The protocol was followed in order to ensure the model was well established and to provide maintenance data on the model in the second year. Such a protocol, however, does not provide data related to children's responses across time as a model is begun and as implementation proceeds until it closely approximates the model.

Teachers who were first trained in Year 3 did not report children and family data. These teachers reported only data related to evaluation of the training and Action Plans. The teachers were trained with the understanding that they would be required to report data if the project's new outreach proposal was funded in the Fall of 2000.

Collecting complete sets of data from outreach site teachers across the various data collection instruments posed a number of problems, ranging from children who moved or were ill to families and teachers who did not return surveys and/or other data. Prior to training, teachers and their administrators signed replication contracts agreeing to provide project staff with essential data. Nevertheless, incomplete data for various data collection instruments occurred in spite of reminders, repeated mailings, and follow-up phone calls to teachers and administrators.

Of the 55 teachers expected to submit data, 28 submitted all required data. Others missed one or more elements. Complete sets of data across children, teachers, and families were most likely to be obtained from teachers who elected to receive WIU course credit. School personnel had the option of signing up for 1 to 3 hours of graduate credit, depending on the number of modules they needed to complete based on the needs assessment. Twenty-five teachers did so. These teachers returned data as requested with one exception—a teacher who found she was going to have a baby and found any extra commitment onerous.

While follow-up site visits by Outreach staff might have alleviated the inconsistency in data collection, funds to do so were not available. After face-to-face training was completed, outreach staff maintained contact with trainees through E-mail, telephone, and regular mail.

Data Analysis

Quantitative data. Data from the *BIT* and *ILA* pre- and posttests were analyzed with paired t-tests, according to Levin's (1999) protocol. Significant relationships at the .05 level between individual variables of the *ILA* and between individual variables of the *BIT* were analyzed with correlation matrices. Responses from surveys targeting teachers and families were reported in percentages. Children with and without disabilities in early childhood classrooms were compared by constructing a 2X2 contingency table and conducting Chi-square testing on ILA and BIT post-test scores.

Qualitative data. The LitTECH database was used to organize, analyze, and compare coded data across data sources. Data related to children, teachers, and families. Child data coded and entered into the database included descriptions from the *Kids and Computer Form*, teacher observations, reports, and surveys by families and site staff, and descriptions of child-created data in *HyperStudio* or *KidPix*. LitTECH staff examined each returned *Kids and Computers* Form, translated the information from each into narrative, then entered the information into the database. In addition, *Kids and Computer* Form responses were analyzed for content.

Teacher data which was coded and entered into the database included *Action Plan Reports*, observations and reports by site staff, and portions of the *Follow-up Survey*. Action Plans were subjected to a content analysis. Family data coded and entered into the database included the *Follow-up Survey* together with observations and reports shared by families.

Qualitative data were coded by categories established in the original research project and entered into a database. The database was sorted by categories. If a category showed 25 or more entries, it was analyzed for patterns of behavior. The coding system used to identify behaviors was developed in the original research study (Hutinger, et al., 1998). It included observable child behaviors related to emergent literacy, communication, social interaction, and related developmental behaviors. Examples include *'identifying environmental print'*, *'labeling items'*; *'dictating stories'*, *'recognizing letters'*, *'articulating key concepts of a story'*, and *'predicting story sequence of outcome'*.

Categories were examined to find common themes across classrooms and children. After analyzing the categories, data were examined for patterns, noting whether the information was obtained across data collection methods. Trends in the data were determined by six LitTECH staff members (four of whom worked on the original research project) reviewing data contained in each code. Staff identified coded behaviors that occurred repeatedly across classrooms, across children, and at different times, then discussed their findings and came to consensus within the group. The procedures and findings used in the present report were audited by an outside auditor, following qualitative research protocol (Denzin & Lincoln, 1994).

Results and Discussion

Similarities between the LitTECH Outreach Project and the Early Childhood Emergent Literacy Research Study (Hutinger, et al., 1998) were found when results were compared. Environmental factors in both the research and outreach classrooms included presence of materials for drawing, writing, making books and reading. Environmental print was located in many places in classrooms. A variety of computer software was available to children in the computer centers. Related off-computer activities as well as those on a computer were offered. LitTECH activities related to curricular themes or the project approach was used.

Similar gains in literacy, according to ILA scores, were found in the earlier study and in the present project. Children showed significant gains in book handling such as holding the book right side up in an upright position and turning the pages one at a time at the proper time. Similar gains were also found in the story variable in behaviors such as retelling the story from memory in sequence and answering questions about the story correctly. Gains were noted in the picture variable including pointing to and labeling pictures in a story.

According to *BIT* results, children demonstrated progress in the following areas: evaluating software and navigating through software programs; using appropriate vocabulary when referring to computer components; and discussing, with their peers, what occurred in the software. Seeking peer assistance was children's most common problem-solving method. Children interacting with adults at the computer remained constant and positive in nature.

Social interaction at the computer remained a constant positive variable in classrooms involved in LitTECH. The majority of the time, at all sites in both research and outreach classrooms, more than one child used the computer. Even if one child started at the computer alone, peers quickly joined him/her at the computer. Turn taking was evident and usually was established by some type of written or picture sign-up sheet. Peer interaction was noted often in observational notes and teachers' reports, as well as in *BIT* data analysis. Families also reported improvement in social interaction.

Findings Related to Children

In the LitTECH classrooms, children demonstrated literacy behaviors, positive social interaction, and computer keyboarding skills. Fourteen significant child behaviors, reported across three or more data sources as shown in Table 2, are discussed below. All fourteen behaviors were found in database entries.

Table 2. Data Sources Indicating Child Behaviors

	Measures				
Child Behaviors	**BIT**	**ILA**	**Database**	**Teacher Follow-up Survey**	**Family Follow-up Survey**
Carries on a conversation	•		•	•	
Articulates key concepts		•	•	•	•
Draws			•	•	•
Looks at or "reads" book		•	•	•	•
Demonstrates emerging writing			•	•	•
Uses invented spelling			•	•	•
Prints letters/words			•	•	•
Makes judgments	•	•	•	•	•
Attends	•	•	•	•	•
Uses related literacy materials			•	•	•
Shares/takes turns	•		•	•	
Demonstrates positive social interactions	•		•	•	
Solves problems	•	•	•	•	
Demonstrates keyboarding skills	•		•	•	

Two child behaviors, *attending* and *making judgments*, were found across all five data sources listed in Table 2. Three behaviors occurred across four data sources: *(1) articulates key story or computer concepts; (2) looks at or 'reads' a book;* and *(3) solves problems.* Nine behaviors occurred across three data sources: *(1) carries on a conversation; (2) draws; (3) demonstrates emerging writing; (4) uses invented spelling; (5) prints letters/words; (6) uses related literacy materials; (7) shares and takes turns; (8) demonstrates positive social interactions;* and *(9) demonstrates keyboarding skills.*

Nine of the fourteen behaviors specifically relate to literacy: *(1) looks at or 'reads' books*; *(2) articulates key story concepts*; *(3) draws* (mark making, from scribbling to images serves as a precursor to writing and communication); *(4) demonstrates emerging writing; (5) demonstrates keyboarding skills, chooses letters with intent; (6) prints letters/words; (7) uses invented spelling; (8) uses related literacy materials* and *(9) carries on a conversation. Positive social interaction* and *sharing/taking turns* were found across three data sources. Such positive behaviors contribute to an environment conducive to appropriate learning and emotional stability.

Comparison of children with and without labeled disabilities. Children with labeled disabilities did as well as those at-risk or without disabilities on more than half the items on the ILA (see Table 3) and on 70% of the items on the BIT (see Table 4). Overall, children in both categories made progress in behaviors tested by these instruments. As shown in Table 3, significant differences at the .05 level or better occurred in less than half the items on quantitative measures. Forty-four percent (7) of the questions on the ILA and 30% (10) of the questions on the BIT demonstrated significant differences between the two samples of children.

Table 3. Significant Differences in Positive *ILA* Post Test Scores Between Children With and Without Disabilities

ILA Question	Without disabilities	With disabilities	χ^2	p-value
3. Child holds book right side up in an upright position.	103	76	3.98	.05
6. Child follows story from left to right and top down with eyes or fingers.	86	46	14.33	.001
8. Child answers questions about story correctly.	93	55	12.58	.001
10. Child retells the story from looking at pictures.	79	43	10.03	.01
12. Child turns pages in normal fashion (right page)	103	73	8.09	.004
13. Child follows text, left to right, top to bottom, with eyes or finger.	77	38	13.66	.0001
14. Turns pages one at a time at the proper time.	91	60	4.87	.03

N= 182 d.f. = 1

Table 4. Significant Differences in Positive *BIT* Post Test Scores Between Children With and Without Disabilities

BIT Question	Without disabilities	With disabilities	χ^2	p-value
4. Uses input device with intent.	97	78	5.09	.02
7. Handles hardware and software with care.	86	60	8.57	.003
14. Expresses enthusiasm verbally to another child.	88	64	7.05	.008
15. Speaks to a peer at the computer.	97	69	15.66	.0001
16. Asks questions to peer about an activity.	85	63	5.03	.03
17. Takes turns at the computer.	89	69	3.92	.05
18. Shares ideas with peer.	81	53	9.87	.002
19. Explains to another child how a device or program works.	73	36	19.79	.0001
20. Can work cooperatively if two or more children are at the computer.	84	51	15.69	.0001
21. Moves to improve his or her view of the monitor without interfering with others.	79	54	7.04	.008

N= 188 d.f. = 1

When comparisons were made, the majority of ILA and BIT items (56%) did not demonstrate significant differences, indicating that children with disabilities made as much progress in those areas as did children who were at risk or who did not have disabilities. While an adult read, both sets of children chose books with intent, attended to the story, labeled pictures in the story, pointed to pictures during the reading, and retold the story from memory in sequence. While children read to an adult, both sets of children held the book right side up in an upright position and vocalized word strings with inflection.

Nevertheless, several significant differences were found between children labeled as having disabilities, and those at risk or "typical," as shown in Table 3. Children without disabilities exhibited some behaviors while being read to by an adult significantly more often than children with disabilities: holding the book right side up, following stories left to right with their eyes or fingers, answering questions about the story correctly, and retelling the story from looking at pictures. Children without disabilities also exhibited the following behaviors significantly more than children with disabilities: following text, left to right with eyes or fingers and turning pages one at a time at the proper time in a normal fashion (right page).

Although children without disabilities exhibited the behaviors cited above more often, children with disabilities exhibited the same behaviors, but at a lower frequency. At the time testing occurred, both samples of children had been exposed to the model for one year. If children with disabilities experienced continued exposure to the LitTECH model, perhaps they would continue to gain skills related to literacy. Whether this gap would decrease is a matter for further study.

When children with and without labeled disabilities used computers, they were comparable in frequency when making independent computer-related choices including independently selecting and doing computer activities, talking to the computer, and expressing enthusiasm physically to another child (e.g., smiling, clapping hands, waving arms). Both sets of children were also comparable in frequency of interaction with adults at the computer by explaining problems, following rules or directions, communicating a process, verbally expressing enthusiasm, and stating at least one rule for using the computer when asked by an adult. In addition, low frequencies of unfriendly behavior toward adults in the computer area and children monopolizing the computer were comparable in both children with and without disabilities.

Although the majority of BIT behaviors (70%) observed between both sets of children were similar (see Table 4), some behaviors were significantly different. Children without disabilities attended to the computer more often and demonstrated technical proficiency more than the children with disabilities. They used input devices with intent and handled hardware and software with care significantly more than those with disabilities.

Collaboration with peers at the computer was significantly different among children with and without disabilities. Children without disabilities exhibited the following behaviors significantly more than children with disabilities: spoke to peers at the computer, verbally expressed enthusiasm to other peers, asked peer's questions about activities, took turns at the computer, shared ideas with peers, explained to peers how a device or program worked, worked cooperatively if two or more peers were at the computer, and moved to improve his or her view of the monitor without interfering with others.

Although children without disabilities exhibited the behaviors cited above more frequently during testing, children with disabilities exhibited the same behaviors but at a lower frequency. According to Odom, McConnell, and McEvoy (1992), preschool-age children with developmental delays often engage in fewer social interactions than same-age peers without disabilities. Multiple studies on inclusion have documented differences in the frequencies of social interactions of young children with disabilities. In relation to these studies, the fact that children with disabilities using the LitTECH model were socially interacting, even at lower frequencies, was a positive and beneficial attribute to their development.

***Informal Literacy Assessment (ILA)* results.** Table 5 summarizes t-test scores for questions on the Year 2 *ILA*. Early Childhood Special Education classes, pre-kindergarten, inclusive, and first-grade classes showed significant increases in children choosing a book with text with intent and children following the story from left to right, top to bottom, with eyes or fingers. These classes, including the third grade classes tested, showed significant increases in children retelling a story in sequence from memory. These classes, except the third grade but including the pre-kindergarten and kindergarten classes, showed significant increases in children actually reading the text. The third grade class had accomplished this task prior to testing. Early Childhood Special Education, inclusive, and first grade classes showed significant increases in children vocalizing word strings with inflection. Table 5 contains corresponding t-test scores.

Table 5. Year 2 Corresponding t-Tests of *ILA* Questions

	Pre Scores		Post Scores		
ILA Questions	**M**	**SD**	**M**	**SD**	***t***
Early Childhood/Special Education N=33					
2. Child chooses a book with text with intent.	.48	.51	.81	.39	$t(32)=4.00$, $p<.0003$
6. Child follows story from left to right and top down with eyes or fingers.	.36	.49	.73	.45	$t(32)=4.28$, $p<.0001$
9. Child retells the story from memory in sequence.	.18	.39	.39	.50	$t(32)=2.94$, $p<.006$
15. Child actually reads the text.	.12	.33	.30	.47	$t(32)=2.67$, $p<.01$
16. Child vocalizes word strings with inflection.	.15	.36	.36	.49	$t(32)=2.94$, $p<.006$

16. Child vocalizes word strings with inflection.	.15	.36	.36	.49	t(32)=2.94, p<.006
Pre-Kindergarten N=65					
2. Child chooses a book with text with intent.	.52	.50	.74	.44	t(64)=3.37, p<.001
6. Child follows story from left to right and top down with eyes or fingers.	.52	.50	.75	.44	t(64)=4.05, p<.0001
9. Child retells the story from memory in sequence.	.31	.47	.50	.43	t(64)=2.39, p<.02
13. Child follows text, left to right, top to bottom, with eyes or fingers.	.46	.50	.47	.68	t(64)=3.37, p<.001
Inclusive N=28					
2. Child chooses a book with text with intent.	.57	.50	.82	.40	t(27)=3.00, p<.006
6. Child follows story from left to right and top down with eyes or fingers.	.57	.50	.96	.19	t(27)=4.18, p<.0003
9. Child retells the story from memory in sequence.	.25	.44	.61	.50	t(27)=3.87, p<.0006
13. Child follows text, left to right, top to bottom, with eyes or fingers.	.50	.43	.93	.26	t(27)=4.50, p<.0001
15. Child actually reads to text.	.21	.42	.43	.50	t(27)=2.71, p<.01
16. Child vocalizes word strings with inflection.	.68	.48	.82	.40	t(27)=2.12, p<.04
Pre-Kindergarten/Kindergarten N=16					
15. Child actually reads to text.	.06	.25	.38	.50	t(15)=2.61, p<.02
1st Grade N=43					
2. Child chooses a book with text with intent.	.86	.35	.95	.21	t(42)=2.08, p<.04
6. Child follows story from left to right and top down with eyes or fingers.	.86	.35	.95	.21	t(42)=2.08, p<.04
7. Child points to pictures now or when reading.	.81	.39	.95	.21	t(42)=2.61, p<.01
9. Child retells the story from memory in sequence.	.79	.41	.95	.21	t(42)=2.20, p<.03
13. Child follows text, left to right, top to bottom, with eyes or fingers.	.86	.35	.95	.21	t(42)=2.08, p<.04
15. Child actually reads to text.	.56	.50	.86	.35	t(42)=4.27, p<.0001

16. Child vocalizes word strings with inflection.	.44	.50	.72	.45	t(42)=4.03, p<.0002
3rd Grade N=10					
9. Child retells the story from memory in sequence.	.05	.53	1.00	0	t(9)=1.00, p<.02

In Year 3, Early Childhood Special Education and pre-kindergarten classes showed significant increases in children holding books right side up in an upright position (see Table 6). They also showed significant increases in children pointing to pictures when reading and turning pages in a normal fashion (right page). Since the kindergarten/first grade class submitted data on only six children, the small sample size prohibited testing that data.

Pre-kindergarten classes in Year 3 showed significant increases in children's book handling by significantly increasing incidents of turning pages one at a time at the proper time and vocalizing word strings with inflection. (See Table 6 for corresponding the corresponding t-test score for pre-kindergarten.)

Table 6. Year 3 Corresponding t-Tests of *ILA* Questions

	Pre Scores		Post Scores		
ILA Questions	**M**	**SD**	**M**	**SD**	*t*
Early Childhood/Special Education N=32					
3. Child holds book right side up in an upright position.	.78	.42	.94	.24	t(31)=2.4, p<.02
7. Child points to pictures now or when reading.	.34	.48	.69	.47	t(31)=4.0, p<.0003
12. Child turns pages in normal fashion.	.66	.48	.94	.24	t(31)=3.4, p<.002
Pre-Kindergarten N=41					
3. Child holds book right side up in an upright position.	.80	.40	.98	.16	t(40)=2.5, p<.02
7. Child points to pictures now or when reading.	.51	.51	.85	.36	t(40)=4.1, p<.0002
12. Child turns pages in normal fashion.	.80	.40	.95	.21	t(40)=2.62, p<.01

***Behavior Interaction Tool (BIT)* results.** In Year 2, comparisons of *BIT* results revealed similar findings in four of the eight grade levels as shown in Table 7. Children in the Early Childhood Special Education, pre-kindergarten, kindergarten/first, and first grade classrooms showed significant increases in handling the hardware and software with care. Since pretest results indicated that children's competencies were at ceiling for the inclusive, pre-kindergarten/kindergarten, second, and third grade classrooms, significant growth was not expected. Early Childhood Special Education, pre-kindergarten, and first grade showed significant increases in children speaking or signing to a peer at the computer and moving to improve his or her view of the monitor without interfering with others. The above grade levels, including the inclusive classrooms, showed significant increases in children asking questions to peers about an activity at the computer. There was a significant decrease in children monopolizing the computer by manipulating, controlling, or directing others in the second grade classrooms tested. One explanation for the decrease in negative behaviors may relate to the fact that the second grade teachers followed the model closely, completed all the modules satisfactorily, and received graduate credit for implementing LitTECH. Second graders used *KidDesk*, a form of sign-up to manage turn-taking at the computer, and software at the most interactive levels (Levels IV and V). Examples of work included Internet searches on geographic places with the same name as the city where their school was located, gathering information via E-mail communication with schools in those places, reporting on information with a word processor, and working as a group to complete a report about the city where their own school was located.

As in the previous Early Childhood Emergent Literacy Technology Research Study (Hutinger, et al.,1998), at the end of the year LitTECH Outreach classrooms demonstrated a greater amount of positive social peer-to-peer interaction at the computer. This was indicated by the significant increase of peers speaking to other peers at the computer, peers asking questions to peers about activities at the computer, and the significant decrease of monopolizing the computer by manipulating, controlling, or directing others.

Table 7. Year 2 Corresponding t-Tests among *BIT* Questions

	Pre Scores		Post Scores		
BIT Questions	**M**	**SD**	**M**	**SD**	*t*
Early Childhood/Special Education N=33					
7. Handles hardware and software with care.	.42	.50	.76	.44	t(32)=3.21, p<.003
13. Expresses enthusiasm physically to another child.	.45	.51	.76	.44	t(32)=3.00, p<.006
15. Speaks to a peer at the computer.	.58	.50	.81	.39	t(32)=3.20, p<.003
16. Asks questions to peer about an activity.	.36	.50	.73	.45	t(32)=4.28, p<.0002
21. Moves to improve his or her view of the monitor without interfering with others.	.36	.50	.67	.48	t(32)=2.73, p<.01
Pre-Kindergarten N=72					
7. Handles hardware and software with care.	.71	.46	.92	.28	t(71)=4.00, p<.0002
13. Expresses enthusiasm physically to another child.	.63	.49	.81	.40	t(71)=2.50, p<.01
15. Speaks to a peer at the computer.	.81	.40	.96	.20	t(71)=3.00, p<.004
21. Moves to improve his or her view of the monitor without interfering with others.	.61	.49	.86	.35	t(71)=4.05, p<.0002
Inclusive N=16					
16. Asks questions to peer about an activity.	.38	.50	1.00	0	t(15)=5.00, p<.0002
Kindergarten/1st N= 12					
7. Handles hardware and software with care.	.50	.52	1.00	0	t(11)=3.32, p<.007
1st Grade N=44					
7. Handles hardware and software with care.	.80	.40	1.00	0	t(43)=3.33, p<.002

15. Speaks to a peer at the computer.	.70	.46	.91	.29	t(43)=3.33, p<.002
16. Asks questions to peer about an activity.	.70	.46	.89	.32	t(43)=2.71, p<.01
21. Moves to improve his or her view of the monitor without interfering with others.	.57	.50	.77	.42	t(43)=2.94, p<.005
Second Grade N=20					
33. Manipulates, controls, directs others at the computer.	.30	.47	.10	.31	t(19)=2.18, p<.04

In Year 3, Early Childhood Special Education and pre-kindergarten classrooms showed significant increases in children looking at the computer monitor to see what happens when input devices were activated, using the input devices with intent, not turning off the computer, explaining to another child how a device or program works at the computer, and communicating a computer process to an adult. (See Table 8 on the following page for corresponding t-test scores).

***Kids and Computers* results.** Children's *"What I Liked Best About the Computer"* responses varied from scribbles on a page without dictated responses to drawings of children sitting at computers—often with more than one child in attendance—to responses saying they liked to work with a friend at the computer. Seven hundred sixty-seven (767) forms were completed, although not all completed forms contained pictures and print. Five hundred thirty nine (539) forms contained drawings. Of those 539 drawings, 58 were scribbles and 253 were drawings illustrating software titles or what children liked to do at the computer (reading, E-mail, working with friends). The remaining 228 forms contained illustrations of the computer center with 84 featuring one or more children at the computer.

On 355 of the 767 forms, children reported activities they liked to do on the computer. One hundred fifty-five children cited general items including games, typing, reading, drawing,

Table 8. Year 3 Corresponding t-Tests among *BIT* Questions

	Pre Scores		Post Scores		
BIT Questions	M	SD	M	SD	*t*
Early Childhood/Special Education N=42					
3. Looks at monitor to see what happens when input device is activated.	.88	.33	1.00	0	t(41)=2.35, p<.02
4. Uses input devices with intent.	.67	.48	.93	.26	t(41)=3.81, p<.0005
5. Does not turn computer off	.64	.48	.90	.30	t(41)=3.42, p<.001
19. Explains to another child how a device or program works.	.14	.35	.43	.50	t(41)=4.05, p<.0002
25. Communicates a process to an adult.	.21	.42	.50	.51	t(41)=4.05, p<.0002
Pre-Kindergarten N=40					
3. Looks at monitor to see what happens when input device is activated.	.78	.42	.95	.22	t(39)=2.48, p<.02
4. Uses input devices with intent.	.53	.51	.85	.36	t(39)=3.91, p<.0004
5. Does not turn computer off	.65	.48	.90	.30	t(39)=3.20, p<.003
19. Explains to another child how a device or program works.	.25	.44	.58	.50	t(39)=3.34, p<.002
25. Communicates a process to an adult.	.23	.42	.53	.51	t(39)=3.67, p<.0007

voice mail, Internet, and E-mail. Two hundred mentioned 73 specific software programs that they liked to use at the computer.

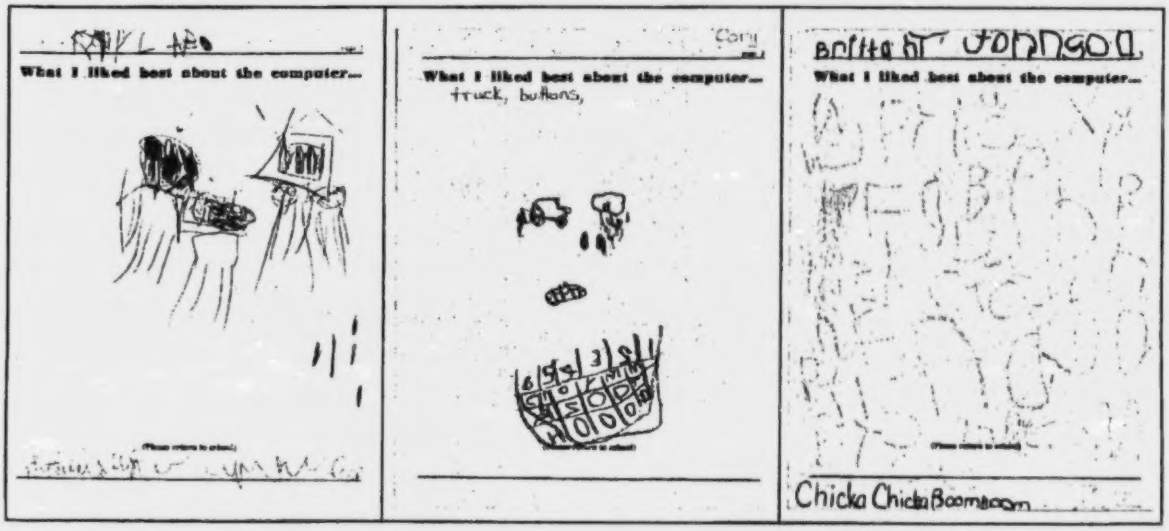
Two hundred fifty two (252) forms contained child writing in different stages. The stages ranged from scribbles to recognizable letters. Following are samples of information from the *Computers and Kids Form* entered into the database. Figure 4 contains images of three completed forms.

- Paige responded, *"mailing stuff to the kids."* Drawings of envelopes in different sizes over the page were done in crayon. Paige wrote her name at the bottom.

- William drew a face with two eyes, nose, smiling mouth and two ears on top of a head. An adult labeled "cat." William dictated, *"I like the computer is that I can draw pictures."*
- The child drew a chicken, cow, and fly. Animals were labeled "chick," "cow," and "Buzzy." Child dictated, *"I like Buzzy on the farm."*
- A child drew mock letters all over page. He dictated, *"Type in some numbers on the computer."*
- Benjamin drew a person with square head and a stick body. He wrote his name at the top of the page in the right direction and backward. He dictated, *"I am playing on KidDesk."*
- Mariah drew two children standing by a square with a rabbit in the square. Mariah dictated, *"I like KidDesk and Reader Rabbit. And I like Blue's Clues."* Mariah wrote her first name and last name at the top in a combination of big and little letters.
- Corey drew a turtle-like shape with three legs (or two legs and a tail), a round body, two hands and a head. He wrote his name in a combination of big and small letters. He dictated, *"I like to play on the computer Franklin!"*
- Kayla drew two sets of two stick figures. Each set was standing by a computer monitor. She wrote her name at the top in big letters with the first letter of her last name. At the bottom of the page she wrote in mock handwriting. Kayla dictated, *"Me and Kourtney at one computer working on Blue's Clues. Malcolm and Etienne at the other computer working on a puzzle game."* (See Kayla's drawing in Figure 4.)
- Cory drew a computer monitor and keyboard. On the monitor, he drew two trucks and a cloud-like shape. The keyboard contained random numbers on the first row with letters on the three rows beneath. Many of the letters were 'O' while some were a variety of letters. There was one letter per key. Cory dictated, *"truck, buttons."* (See Cory's drawing in Figure 4.)

- Brittany wrote letters all over the page. Most letters were capital letters. Brittany wrote both her first name and last name at the top of the page. She dictated, *"Chicka Chicka Boom Boom."* (See Brittany's work in Figure 4.)

Figure 4. Examples from the *Kids and Computers Form*


What I liked best about the computer...
What I liked best about the computer...
truck, buttons,
What I liked best about the computer...
Chicka Chicka Boom Boom

Patterns of child behavior. Table 2 on page 40 shows the data sources entered into the LitTECH database together with major patterns. The child behavior categories listed below contained significant patterns and illustrate behaviors of children as they interacted with software and related materials. The patterns in each category are supported by at least three data sources. Similar significant patterns were found in the original study. However, the original study did not find significant patterns of social interaction among children when they used software created with *HyperStudio* or significant patterns in articulating key story concepts, printing letters/words, or keyboarding (choosing letters with intent) when they used tool software.

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Children's behavior patterns as they interacted with software, other children and adults, and related materials were organized according to three types of LitTECH curriculum software: (1) literacy-based software, (2) tool software (drawing and writing programs), and (3) *HyperStudio*. As expected, the majority of significant literacy behaviors occurred when children used the literacy software recommended in the LitTECH curriculum. However, across the three types of software four significant patterns were repeated: (1) printing letters and/or words; (2) drawing; (3) making judgments; and (4) positive social interaction among children. Articulating key story concepts occurred in both literacy and tool software.

1. Children's interaction with literacy-based software and related materials:

Carries on a conversation. Children held cooperative discussions when using the literacy-based software on a computer.

Articulates key concepts. Children articulated information about key story concepts and about their own stories as well as key concepts about computer use.

Draws. Children scribbled, drew shapes, drew images of software programs, and drew computers with images on monitors.

Looks at or "reads" a book. Children read classroom 'library' books, computer-made books, and the hard copy of books that came with the software programs.

Demonstrates emerging writing. Children in this stage used mock letters for their name on a sign-up sheet.

Uses invented spelling. Children, using invented spelling, wrote words and sentences. They also wrote their names when using the sign-up sheet.

Prints letters/words. Children printed random letters and long sentences. When children printed words, they printed their own names as well as software titles.

Makes judgments. Children made judgments about their own software preferences as well as what to do in individual software programs (what to click on, where to go). Children made judgments about whether to E-mail and what to say in the E-mail; whether they liked to use the computer; if they needed peer help at the computer; or if they could help others in a software program. Children made judgments about using a sign-up book, including where to sign on the sheet, how to write their name, what color to use in writing their name, and how to cross off their name. Children made choices regarding their preference for working with other children when using the computer.

Attends. Children paid attention to and focused on the software's activities, sounds, or music. Children observed intently, at times responding verbally to what the characters in the software said and at other times using the input device to make responses. Observers at the computer also attended to the monitor and made verbal responses, pointed to the monitor, or made suggestions to the peer controlling the input device.

Shares/takes turns. Children shared and took turns when using the sign-up sheet with very little adult direction. When children used the computer they took turns. Children assisted peers at the computers by helping through trouble spots or being the peer tutor.

Demonstrates social interaction with peers. Children interacted with peers or adults at the sign-up sheet location. Children interacted with peers as they used software programs at the computer and some functioned as peer experts. Conversations occurred as children interacted, centering on what was happening in the software program or at the computer center.

Uses related literacy materials. Children used content of the sign-up books for turn taking and used hard copies of books related to the software programs.

2. Children's interaction with tool software (drawing and writing programs):

Draws. Children drew when involved in work related to curricular themes and/or projects.

Demonstrates social interaction with peers. Children sought peer assistance when using drawing and writing programs. Children interacted with each other positively when working on projects on the computer. They also used *KidDesk* to communicate with each other through E-mail and voice mail.

Articulates key concepts. Children articulated key concepts in stories or computer uses when working in projects, E-mailing friends and family, and when choosing software.

Makes judgments. Children made judgments on how to manipulate and navigate through drawing and writing programs as well as showing preference for specific software programs and *KidDesk*.

Prints letters/words. Children printed letters and words regarding their software preference, wrote their names, and wrote for curricular-related projects or activities in the classroom.

Demonstrates keyboarding skills, chooses letters with intent. Children chose letters with intent when using the notepad or E-mail in *KidDesk* and when keyboarding in project-specific work related to the classroom curriculum.

3. Children's interaction with *HyperStudio* and related materials:

Draws. Children used the *HyperStudio* tools to draw. Drawings were topic specific to the project on which they were working. For example, if the project was a retelling of the story of *The Three Bears*, the drawings related to the parts of the story or were pictures of the bears. If the topic was *All About Me*, children's drawings were of themselves, family members, pets, or their house.

Solves problems. Children solved problems when they were planning *HyperStudio* stacks. These problems related to how to tell the story and what audio, text, and images to use.

Makes judgments. Children made decisions about what to do in the program, what the stack would contain, and what it would look like. Their decisions related to choosing the content for the stacks (e.g., the text, voice recordings, sound, and images); the types of buttons to use (i.e., visible or invisible); the colors of the visible buttons; and the color, size, and font of the text.

Demonstrates social interaction with peers. Children interacted when using *HyperStudio* when working in small groups to create *HyperStudio* stacks.

Teachers' observational reports on LitTECH's impact on children. Teachers' classroom observations, entered into the LitTECH database, provided a view of children's literacy behaviors gained during participation in LitTECH. Observational reports supported findings from the quantitative measures. Across sites and grade levels, teachers commented positively on the implementation and effects of LitTECH. As children participated in literacy activities at the computer and interacted with software, teachers noticed and reported definite changes related to understanding letters and words, realizing that letters make sounds, writing, using expressive language, communicating with others, problem solving, and increasing attention spans. Examples of comments received from teachers follow.

Communicating:

- *"As the children dictated what they drew each day and listened to others' dictation, their language skills were enhanced."*
- *"I have noticed lots of conversation among the children at the computer."*
- *"The language that was involved in the computer center is eye-opening."*

- *"Kimberly finally chose the computer. We put in the Living Book, Just Me and My Dad. She was learning the mouse and became very excited when she clicked and something happened. She has very limited language and kept saying, 'I did it.' She even said to Tucker, who was watching, 'you do it,' and 'you watch.'"*

Drawing:

- *"For the HyperStudio classroom project, the students created a card for each day at school. They drew pictures of something they did on each day. These pictures were scanned and then placed in HyperStudio where they were able to vote on animation for each picture."*
- *"We observe the children recognizing colors and using describing words. As Audrey was moving the mouse up and down while painting, I heard her saying the words 'up' and 'down'."*
- *"Children drew pictures and then we recorded words to describe the drawing."*

Emergent writing:

- *"Tylon typed her own name on an e-mail letter."*
- *"I see children pretending to write not only in the writing center, but in other centers as well."*
- *"Books are created from computer software. Children were writing more in the writing center and other areas."*

Making judgments:

- *"Joseph noticed upper and lower cases on the one keyboard. He wanted to know why there were two a's on that key and generalized the explanation for the other alphabet keys. Then he commented, 'But not up here because these are numbers, huh!' Kaitlin (good friend of Joseph's) saw that the other keyboard did not have lower case alphabet letters on it and* *wanted them added. She could not find all the letters of the words and names she was copying when lowercase was used."*

- *"Mackenzie is able to move comfortably to the computer and to problem solve and just "try it" and see what happens. There is no more crying, and she can verbalize something to try, do it, and come up with another alternative when it doesn't work. She turns to her peers as "experts" only after she makes two tries her self. Note: This is carrying over to her play in other areas, where she usually sought adult help immediately to fix/solve the problem and then went immediately to peer help when things didn't work the first time. Now she is trying twice before requesting help herself."*
- *"Julie is showing much greater preference for Living Books [software] compared to last year.*

Attending:

- *"Julie has better story attending at the computer than on carpet or in quiet area."*
- *"The computer is a lifesaver for the new student we just started last week. He always chooses the computer first. He attends to the computer longer than any other activity."*
- *"We started a new, very young student. Tucker found the computer calming. His attention span increased while doing the Living Book, Sheila Rae the Brave."*
- *"Jesse demonstrates a longer attention span at the computer."*

Social interaction:

- *"Nicholas was playing Sammy's Science House, and he knew where a piece went as he was clicking and dragging. He didn't get it in the exact spot to stick. He was persistent and did it about six times and was successful. Nick had previously watched Austin doing a game, and he called Austin over for help to find out where the game was. It was good to see them working together."*

Keyboarding, choosing letters with intent:

- *"Steven was typing a response to Josh's e-mail. He was typing his name and forgot an e. He knew how to delete and put his e in and then complete the word."*
- *"Jesse got an e-mail at school, and he answered it. He started typing with his j for "Jesse" and he said, See my j? He also recognized some numbers when he was typing."*
- *"Andrea got an e-mail from her sister on March 30. Then Andrea and I sat at the computer to respond to the message. She typed 'K' for Kaitlyn and an 'A' for Andrea. She needed only a little help finding the letters for her name."*
- *"We have been e-mailing other students. When the students get to do their own typing, Nick typed his name and made many n's for his name."*
- *"Students recognize letters from e-mail."*
- *"Richie commented, "This word begins with 'R' like my name!" He clicked on it and —surprise—it wasn't his name after all! This led him to looking at more than the first letter to compare names/words. He also began wanting to print more letters of his first name for sign up so others wouldn't try to take his turn, thinking it was their name. He pointed this out to a few of his favorite friends, prompting them to also add more letters to their names!"*

Identifying and/or reading words:

- *"Eric is interested in words and has begun word recognition. He randomly clicked on words out of story order in any programs that let him and in the Living Books stories; he clicked on single words, in story order. By clicking on rebus to words in Green Eggs and Ham over and over, Eric memorized the entire story."*
- *Understanding the concepts of print.*

- *"Seeing their own words being printed and then being able to click on the word/sentence buttons made them aware of what a word/sentence is."*
- *"Zachary dictated his own letter to Jacob. He is learning his words are print. (I think all students are doing this because we are sending letters often)."*

Findings Related to Teachers

Action Plans. Teachers' Action Plans, described on pages 28 and 34, were followed by reports to LitTECH staff regarding each plan's implementation. Figure 5 contains sample statements from representative Action Plans.

Modules 1 and 2 Action Plans related to the physical environment of the classroom computer center, implementing *KidDesk* software, using a sign-up method, and using technology to include families in education. An analysis of 98 Action Plans showed that teachers intended to make changes in their programs. A single teacher could plan more than one change in these Modules. Plans related to moving the computer center closer to quieter areas, reading centers, and writing centers. Plans also included making more space or adding chairs so children could work together at the computer center. Fifty-one teachers planned to use and customize *KidDesk*. Forty-two teachers planned to implement a sign-up method. Twenty-five teachers planned to change the classroom environment—to move the location of the computer center, making it more accessible to children. Nine teachers planned to add books to their technology environment to support software programs, to implement an extended schedule to allow for more computer time, and to use the computer in small and large groups in addition to free time.

Module 3 Action Plans related to selection and integration of children's software into the early childhood curriculum. Eighty-five teachers completed Action Plans for this Module. After reviewing software titles, teachers chose one that would support their curriculum. Analysis of the plans indicated that 51 teachers planned to use concept/activity software programs (e.g., *Let's Explore the Farm, Amazing Animals, Busytown*) while 19 teachers planned to use interactive story software programs (e.g., *Just Me and My Dad, Chicka Chicka Boom Boom, Stellaluna*). Fifteen teachers planned to use writing and drawing programs (e.g., *KidPix, Claris Works for Kids, Corel WordPerfect*).

Of the 70 teachers using concept/activity and interactive story software programs, 41teachers planned to integrate the software into thematic units, while 15 planned to use the software to teach skills including rhyming, letter recognition, time, patterns, similar/different, and routines. Fourteen teachers planned to incorporate software into the curriculum, but did not plan a theme or project. These teachers focused on skills found in the software that would work well with children in their programs. Of the 15 teachers using writing and drawing programs, 11 planned to integrate the program into a unit, while others planned to use it for children to draw and write with no specific unit planned. Five teachers planned to use websites to supplement the software integrated into their units.

Module 4 Action Plans related to the use of *HyperStudio* to retell favorite stories, support skills, and author new stories. Sixty-six teachers completed Action Plans for this Module. Twenty-four planned *HyperStudio* stacks related to sharing information about the school, teachers, children, activities, and friends. Seventeen stacks related to repetitive stories and favorite books while another 17 were used to support curriculum units such as transportation, farm, ocean, and dinosaurs. Eight stacks were based on number, alphabet, or color concepts.

Figure 5. Sample Statements from Teachers' Action Plans for Modules 1 - 4

Module	Action Plan	Strategies
1 - 2	Plan for Applying a Selected Emergent Literacy Strategy	• I plan to have a sign-up sheet for the children to have a turn at the computer. • I plan on providing books related to the programs the children are playing. • I plan to notify parents of the possibility to work on the computer with the children. • I will install children's photos on their individual desk choice [in KidDesk]. I will have parent's leave an oral/written message for their child.
3	Plan for Integrating an Interactive Emergent Literacy Software Program	• I will use Dr. Seuss's ABC CD-ROM. Children can click on words/letters they want to discover. They can listen to and sing the ABC song. The activity will be extended by creating a classroom word book. Children will draw a picture. Adults will help them label their pictures or will write what they dictate about the picture. This can be used in a classroom HyperStudio stack. Children will see and identify environmental print signs such as McDonalds, Coke, candy bar wrappers, and cereal boxes.
4	Plan for Integrating a *HyperStudio* Program	• I will create a stack based on color concept. I will write a poem integrating colors and color words. Cards will be developed for each color with animation of objects that could be associated with each color. • I will create a stack based on days of the week. The children will draw a picture on each day at school. One picture will be chosen for each school day. These pictures will be used in HyperStudio to compose a week book, "What did you do at school today?" • I will create a transportation stack with categories for air, ground, and water.

Follow-up Survey. In May 1999, 19 teachers completed the Follow-up Survey. Thirty teachers completed the evaluation in May 2000. Six teachers who responded to the Year 1 Survey also completed the Survey in Year 2. No significant differences in their responses were found. Because consistent findings were revealed in both years, data was combined for analysis.

Results of the survey are consistent with teachers' observational reports of child behavior cited on pages 57-61. Teachers reported the following child literacy behaviors in their classrooms after LitTECH training: recognizing names and letters; children being more proficient with software and more confident in exploring the software and web sites; the beginning of reading literacy; using *KidDesk* more proficiently; increased communication among the children overall; and children's increased interest in using *HyperStudio*. Teachers also noted that children used the keyboard more, depended more on peer helpers instead of teachers, increased independent problem solving, connecting spoken word to print, and recognized letters and numbers.

Teachers reported using the computer during center/free choice time (43%), in small group (8%), large group (6%), and throughout the day (10%). Surprisingly, only 30% reported using a sign-up sheet (30%) to facilitate children's computer use. Rotation (16%) was encouraged in the center. Some teachers used adult modeling, assistance, and encouragement (8%), along with peer helpers (8%) at the computer when children needed support. A few teachers (8%) introduced new software to children in a group setting.

The LitTECH curriculum included appropriate software. However, teachers recommended the following software to support emerging literacy behaviors in young children: *Living Books* published by Broderbund (40%), *KidDesk* by Edmark (30%), *JumpStart* series (20%), *HyperStudio (18%),* and *Kid Pix* (10%).

Teachers reported both years that *KidDesk* was used to allow children to have an individualized desktop to access appropriate programs for their developmental level (35%), to protect teachers' files (30%), and to encourage independent computer use (20%). It was also used to give children a tool for communication (10%) and more independent choices (8%).

Teachers reported that they used software to reinforce or supplement a thematic unit in the classroom (43%). Teachers used software during center time to match the theme in the class (33%). They used the Internet as a research tool to supplement thematic units (8%), (e.g., to watch a chick hatch via web cam or to look up information on other U.S. towns named "Macomb"). They occasionally used *HyperStudio* as an integration tool for curricular units (8%).

When asked how they supported children's self-direction, teachers reported that peer experts emerged at the computer center (47%). Other techniques, used less frequently, included letting children use the computer to explore on their own (24%), using a sign up method (18%), allowing the children to select their own software to use (12%), using *KidDesk* (10%), providing support when asked (8%), and others monitored success from a distance (6%).

Teachers rated peer assistance high as a way to solve problems in the computer center (49%). Teachers also encouraged children to try solving problems on their own (29%) or to try other solutions before going to an adult or peer (12%). Other problem solving strategies included an adult talking a child through the procedure (8%) and an adult asking the child questions about the problem solving strategies he/she has already tried (6%).

Teachers were asked about changes they made to the classroom computer environment. Responses included: changing the physical environment (20%), changing the management of the computer in the classroom (20%), using the computer more (16%), and purchasing and using different types of software (16%). According to teachers, environmental design factors that promoted literacy development included making materials available for writing near the computer (49%), the implementation and/or improvement of the book area (41%), and labeling items in the classroom (35%). Digital cameras were the most popular peripheral used in the classrooms (63%). Other peripheral devices mentioned included scanners (24%) and drawing tablets (8%). In 1999, 74% of the teachers reported designing a *HyperStudio* stack. In 2000, half (50%) of the teachers reported designing a *HyperStudio* stack.

Teachers communicated with parents about children's progress using technology through parent/teacher conferences (39%), an invitation for parents to observe in the classrooms, informal discussions when parents visited, or in home visits (29%), and adding technology experiences in parent newsletters (27%). A few teachers also placed children's samples in portfolio work (8%).

Teachers reported including parents in technology and literacy activities by encouraging parents to volunteer in the technology center (20%) and to visit and observe the children at the computer (16%). Teachers reported including special incidents and experiences of children at the computer in parent newsletters (14%) as well as sharing names of good interactive software titles with parents (6%).

Teacher results—Model Fidelity Profile. The Model Fidelity Profile was completed by 27 teachers in Year 2 and 26 teachers in Year 3. Funds were not available for on-site visits for LitTECH staff to complete the Profile, although that may have provided a more accurate picture of model adoption. Most frequently, teachers indicated that they were, indeed, using elements of the LitTECH model. Analysis of the Profile responses indicated that teachers in both years consistently reported that they adhered to the LitTECH components. However, in conjunction with responses on the Follow-up Survey, in comparison to elements considered to be important to the model, such as the surprising low number of teachers reporting that they used a sign-up method, the responses to the Model Fidelity Profile contain data that indicates non-conformance to the model. On the other hand, the LitTECH staff who worked with the teachers, providing ongoing assistance via E-mail and phone, suggest that some elements of the model became so integrated into teachers' classrooms that teachers neglected to single out using a sign-up method when they filled out the survey. Teachers were responsible for filling out a number of forms in a limited amount of time. Nevertheless, the discrepancy suggests that further study of sign-up methods and their effects on teachers is needed. The question is currently being investigated in a research study focusing on the model. [4]

Implementing the LitTECH Curriculum was addressed in the Profile. In the second and third years, 93% of teachers reported integrating software into classroom projects and/or the curriculum. Using books to accompany interactive software remained constant at 89% in both years. A slight (16%) increase in teachers using the Eency Weency Web was revealed between the second and third years (from 15% to 31%), and 42% of the teachers in both years reported using the LitTECH homepage. Year 3 teachers used *KidDesk* 10% more with their children than Year 2 teachers (from 71% to 81%). At the end of Year 3, the majority of teachers (96%) continued to model new words that were related to software and play.

Classroom environments corresponded with the model, according to the teachers. In both years, all teachers indicated that the computer monitors in their classrooms were placed at children's eye level, that two or three chairs were located in the computer center, that their computers had a CD-ROM drive, and that they facilitated activities related to children's experiences. All reported that they encouraged children to share freely, talk with one another, use software, and ask questions to promote and support oral language and reading. In both years, 96% of teachers reported having writing materials accessible to children and environmental print present in the classroom. There was an 11% increase from Year 2 to Year 3 (from 81% to 92%) in teachers reporting having an art center open to children, encouraged by the model which assumes that the marks children make precede writing letters and words.

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[4] Disseminating and Replicating an Effective Emerging Literacy Technology Curriculum, PR #H327A000036

The Profile included questions about classroom technology materials and equipment. Between Years 2 and 3, teachers reported an 11% increase (from 85% to 96%) in the number of color printers in the classrooms. Teachers increased their use of a microphone with the classroom computer by 10% from Year 2 to Year 3 (from 74% to 84%). *KidDesk* use increased from 67% to 74%, a 7% increase. Teachers also reported a 2% increase (from 82% to 84%) in the availability of a variety of drawing and writing programs for children's use.

A family involvement component is included in the Model Fidelity Profile. In both Years 2 and 3, 90% of the teachers reported encouraging family input and feedback while 81% reported sending technology activities and resources home to families. A 12% increase occurred from Year 2 to Year 3 in teachers providing opportunities to families to create technology activities (from 15% to 27%). In Year 2, not one teacher reported families using the Eency Weency Web (a part of the LitTECH web site, described on page 77). However, in Year 3, 8% of the teachers reported getting input from families who used the Eency Weency Web.

Participant Satisfaction Survey. Responses to the Participant Satisfaction Survey were collected from 26 participants in Year 2 and 31 participants in Year 3. The mode was determined, as well as a count of specific responses. In both years, some teachers did not provide responses to some questions.

Data show an 11% increase in teachers' comfort levels in using the computer from Year 2 to Year 3. While more teachers felt that they knew a lot about technology, they wanted to learn more. This finding was consistent with teachers' use of technology in the classroom.

The Survey included a section to evaluate respondents' satisfaction with the project's toll-free help line. From Year 2 to Year 3, those who called the Center reported a 7% increase in LitTECH staff immediately responding to calls (from 85% to 92%). In both years, 100% reported getting their phone call returned within two days, being treated with courtesy, and receiving information that was helpful. A 28% increase in preferring to communicate via a toll-free line to other methods was evident in Year 3 (from 42% to 70%). However, in Year 3, 40% of the teachers did not respond to all questions in this section.

The Survey's Internet evaluation revealed that approximately 70% of those who responded had accessed the LitTECH homepage. Seven teachers in Year 2 and six teachers in Year 3 reported not having access to the Internet at school or at home. Approximately 85% in both years reported receiving helpful information from the web site. In both years, approximately 60% of those who responded to this section preferred communicating via the Internet to other methods.

Findings Related to Families

Families' perception of the LitTECH project were collected with the *Family Satisfaction and Follow-up Survey* at the end of the school year. One hundred fifty-three (153) surveys were returned in Year 3. Because the surveys were returned without family names, responses cannot be compared to classrooms and/or child results. Sixty-one (40%) questionnaires represented children who had worked with technology in the classroom for less than 6 months, 56 (37%) questionnaires represented one-year participants, 34 (22%) represented 2-year participants, and two (1%) questionnaires represented 3-year participants. Slightly more than 50% of the families reported satisfaction with their children's experiences in LitTECH.

Family participation in LitTECH. Out of the 153 respondents, 83 (54%) reported receiving information about technology activities, 54 (35%) observed interactive technology activities, 78 (51%) participated in literacy activities at home, 40 (26%) participated in LitTECH activities during school time and seven (5%) participated in LitTECH activities during after school workshops.

A variety of family members were involved with LitTECH. Out of the 153 returned surveys, 138 (90%) reported mother involvement; 33 (22%) reported involvement by fathers, 59 (30%) reported involvement by brothers or sisters, and 29 (19%) reported involvement by "others," which included friends, neighbors, aunts, uncles, grandparents, and cousins.

Perceptions of benefits from involvement in LitTECH were requested from families who participated in the curriculum. One hundred and forty nine families (97%) reported that they felt their child benefited from involvement with interactive technology activities. Sixty-eight families (44%) reported that their children positively interacted more with others. Eighty-six (56%) reported better communication and language development in their children. One hundred and one families (66%) reported better listening skills in their children. Improvement in reading skills, 41 (27%) and writing skills, 47 (31%) was also reported in participating children.

One hundred and twenty nine families (84%) reported that they had gained knowledge and/or skills from being involved in literacy activities with their children. Thirty-two families (21%) reported gaining knowledge of emergent literacy and how technology is used as a tool to communicate with their children. Forty-five (29%) gained knowledge in how their children acquired emergent literacy skills. Forty-six (30%) learned how technology helps their children gain emergent literacy skills. Seventy families (46%) reported gaining information on computer programs and activities for their children, while 73 families (48%) indicated better understanding of what their children do with technology.

Families were asked to report any changes in the home related to technology and literacy. Thirteen respondents (8%) reported purchasing and encouraging the use of a variety of developmentally appropriate software for their child at home, 9 (6%) purchased a home computer for their child, and 8 (5%) reported allowing their child more time and options on the computer at home. Examples of parent comments follow.

- *"The program [LitTECH] enhanced what we already do at home."*
- *"We upgraded our computer from Windows 3.1 to Windows 95 so we can get more educational games and access to the Internet.*
- *"Thank you—the more computer experience the better!"*
- *"Could LitTECH Interactive be used at home also to reinforce learning at school?"*
- *"We are more aware of Cory's language skills and how he develops."*
- *"She listens to what we say to her."*
- *"Matthew, who has autism, has responded to this technology program far more than any other medium we've tried. The teacher's enthusiasm for our involvement is such a refreshing change. Thank you so much."*

Implementing the model. Specific patterns of classroom teachers' behaviors across data sources related to methods that teachers used in implementing the LitTECH model and matched findings in the original research project. Table 9 lists the teacher behaviors and data sources supporting each behavior. Each behavior listed is supported by three or four data sources.

Table 9. Data Sources Showing Effective Methods Used by Classroom Teachers

	Measures			
Teacher behaviors that contribute to children's literacy development:	**Database**	**Action Plan Report**	**Teacher Follow-up Survey**	**Model Fidelity Profile**
Uses a sign up method for management of the computer	•	•	•	
Uses *KidDesk*	•	•	•	•
Implements software curriculum integration activities into the program curriculum	•	•	•	•
Authors *HyperStudio* Stacks	•	•	•	•
Changes the computer environment to implement model	•	•	•	•
Integrates Family Activities	•		•	•

When teachers used a sign up method to manage computer use, children were able to manage their own use of the computer using a practical method that promoted emergent writing. Children could then stay on task in other activities without feeling anxiety about missing their turn. The sign up method allowed children to practice writing no matter what stage of development they were in and allowed for practice in reading names of other children.

The use of *KidDesk* as desktop management software decreased teachers' anxiety about allowing children to control the computers. *KidDesk* not only provides teachers with tools to manage the hardware and software at the same time but also provides children opportunities to make choices about software they wish to use and to manage their choices. Children were able to make a one-to-one correspondence between the icon and the software and to follow a systematic method for opening and using a program. The program offered ubiquitous communication tools for children to use within the classroom environment, including E-mail and voice mail to communicate with peers and family members.

Teachers chose software to complement and aid the learning taking place in the classroom. The computer was no longer a stand-alone center in the corner of the room with unrelated programs available to children. The computer in the classroom became part of the learning theme or project and became a tool to meet standards in the early childhood curriculum. Teachers reviewed programs for interactivity as well as content related to classroom activities. Using the computer offered access to curriculum for struggling children.

When teachers authored *HyperStudio* stacks or related multi-media software, which was at a high level of interactivity, children experienced many literacy opportunities. Teachers used the software to teach concepts, to share experiences, to tell stories, and to report learning. Beginning with blank cards, children built 'stories' through use of voice, text, images, and video.

When teachers changed the computer environment to implement the LitTECH model, changes included making the environment more accessible to children, adding more seating to the computer area, allowing children to make software choices independently, and putting books and other print materials near the technology center. Teachers also added more technology, such as digital cameras, scanners, and additional computers.

Family activities ranged from sending awareness materials home to joining in classroom activities. Some families shared stories for reports while others sent E-mail to classrooms.

Teacher skills. Teachers need a set of technology skills in addition to those related to literacy. Skills needed to implement the model include those necessary to set up and use peripheral devices (e.g. digital cameras, scanners), to choose and use children's software programs, and to integrate software-related activities into the program curriculum. They also need the tool software skills to author *HyperStudio* stacks or use other multi-media production software such as i*Movies, KidPix Studio,* and *Movie Works Deluxe*, and to set up the *KidDesk* program.

Using *HyperStudio* was difficult for some teachers. Learning the procedures required to produce stacks, becoming comfortable with the program's features, planning and creating the stacks, and using the program with children in a classroom setting were time-intensive activities. Of those who reported on the Model Fidelity Profile, 9 teachers (20%) did not want to spend what they considered precious time learning *HyperStudio* and creating stacks using the program. However, about over half of the teachers did use *HyperStudio.* Teachers who replicated the model in LitTECH tended to use alternative multi-media software programs (e.g., *KidPix Deluxe*) that offered the same level of interactivity as *HyperStudio.*

Table 9 not only shows procedures that are effective in carrying out LitTECH experiences but also reflects the procedures useful in promoting maintenance of the model. The child data reported is based on teachers' second year replication activities, which indicate at least 1 year of model maintenance after initial training. Model Fidelity reports are also based on maintenance of the model into a second year. Four continuation sites were part of the original research study, so the procedures used by those teachers demonstrate procedures and conditions useful in maintaining the model. Comparisons of data from continuation sites and replication sites are currently being conducted. See the Future Activities section, page 78, for more details.

Project Impact

Conference Presentations and Publications

Staff members presented at ten conferences (national, regional, and state) during the projects' 3 years. More than 360 early childhood educators, therapists, professionals, and family members attended these presentations. Among the presentation topics were *HyperStudio,* *Literacy, and the Internet; Promoting Literacy through Interactive Software;* and *Merging Literacy and Technology for the Early Years.*

LitTECH staff members contributed over 12 articles for publication. The publications included a book chapter, invited publications, and contributions to a quarterly newsletter.

Products

Products developed by project staff included print, video, and electronic materials. The following sections provide details about each.

Curriculum. *eMERGing Literacy and Technology: Working Together*, a 490-page curriculum focused on the adaptation and integration of software titles into an early childhood classroom underwent revisions and additions, was first published in 1997 then revised in 1998 and again in 2001. Curricular activities, primarily child-directed, were designed to promote literacy development at the computer center, the reading center, and other curricular area, and daily home and classroom experiences. A description at the beginning of each activity in the curriculum explains the links between the software and children's learning. The curriculum reflects the reading research recommendations for early childhood made by the National Research Council's *Preventing Reading Difficulties in Young Children* (Snow, Burns, & Griffin, 1998). Sections of the curriculum are available on the LitTECH web site. The curriculum is available from the Center for Best Practices in Early Childhood and the Curriculum Publications Clearinghouse at Western Illinois University.

Video. In December 1998, project personnel participated in an interactive satellite broadcast sponsored by Illinois STARNET. The broadcast, titled *Children as Storytellers to the World: HyperStudio, Literacy & The Internet*, focused on the use of *HyperStudio* with young children with disabilities. The broadcast detailed the uses of *HyperStudio*, an authoring program, as a tool for developing emergent literacy skills such as language, emergent reading, and early writing development. The program contained clips of interviews from early childhood teachers discussing the ways they use *HyperStudio* in their program (e.g., reliving classroom experiences, retelling familiar stories, authoring new stories, reinforcing and facilitating learning activities and experiences at home and in the classroom). Sample *HyperStudio* stacks developed by teachers and children were shown. The program was taped and is now available on video from the Curriculum Publications Clearinghouse at Western Illinois University.

A second videotape, *LitTECH Interactive Presents: The Beginning of Literacy* was developed as an overview of the effects of technology on emergent literacy. *The Beginning of Literacy* introduces concepts of print and stages of emergent writing, shows preschool children using the technology, and demonstrates how interactive stories, drawing programs, writing programs, and authoring software may be used to encourage early literacy. This video is available from The Center for Best Practices in Early Childhood.

Web site. A LitTECH web site <http://www.mprojects.wiu.edu/littech/> was established in November 1997. The purposes of the site were to disseminate awareness information, to announce training opportunities, to make training materials available, and to provide electronic consultation services. The site contained information about LitTECH and its benefits to children, staff, and families; requirements for participation in LitTECH; upcoming training dates and biographies of LitTECH training staff; general information for participants; new curriculum integration ideas developed by participants during training events as follow-up activities; links to other web sites with information about web page development; current information on educational buys, software companies, and hardware information. The site included a FAQ

(Frequently Asked Question) feature. Evaluation forms uploaded as PDF files can be downloaded by participants, printed, and filled out to report information.

Eency Weency Web, located on LitTECH's web site, provided a place where LitTECH participants could work in a user-friendly site and participate in literacy activities. The home page displayed a preschool classroom with easily recognizable icons accompanied by sound and short text. Children could navigate the site on their own, making independent choices. The drawing was done by a Chicago artist, scanned, and then colored in *Adobe Photoshop*. The image contains learning centers typically found in preschool classrooms. Children can be found in the image at the computer, mailbox/writing, art, and housekeeping centers. The teacher is located on the image as well. The image map contained hot spots on the children and teacher. When the children at the computer center are clicked on, the viewer was taken to a popular children's web site (e.g., Legos, M&M's, Winnie the Pooh, Jan Brett Home Page). A click on the child at the mailbox in the writing center took the viewer to a pen pal site. At a site like Kids' Space Connection or ePALS Classroom Exchange, children could get a pen pal or a classroom could select another classroom to exchange E-mail with. Both sites are global, connecting children from around the world. When the child at the table writing was clicked on, children were linked to *HyperStudio* stacks created by LitTECH participating classrooms. The child at the easel connected the viewer to an on-line scribble pad. The housekeeping center hot spot linked to sites featuring various interactive sites and/or LiveCam sites. When the teacher was selected, the image map linked to resources for the classroom teacher focusing on literacy and technology. LitTECH staff developed interactive activities using *Authorware 4.0.*

Future Activities

The first priority for future activities is to continue dissemination, training, consulting, and establishing replication sites. To this end, in December 1999, The Center for Best Practices in Early Childhood proposed and was subsequently funded to engage in a Steppingstones 3 'Research on Implementation' project titled "Disseminating and Replicating an Effective Emerging Literacy Technology Curriculum (ELiTeC).[5]" ELiTeC is based on the initial 3-year literacy technology research project and the 3-year LitTECH Outreach project. ELiTeC's 3-year funding period began October 1, 2000. The project's major goals are to (1) disseminate information; (2) replicate and validate the original research findings in a range of typical rural and urban educational settings; and (3) study the project's implementation and maintenance as demonstrated by replication sites. This funding allows the Center to make further comparisons among sites and the original model and to determine both site and teacher characteristics that lead to successful replication.

Project staff provide replication sites with ongoing staff development training and support for teachers, professional staff, and families. The project currently serves three groups of multiple, complex sites, both rural and urban. Group 1 sites are close to Macomb and participate Years 1 through 3. Group 2A and 2B sites, further from Macomb, are scheduled for replication in Years 2 and 3. Group 3 consists of two teachers who participated in the original research study and five teachers who adopted the model during the model development period.

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[5] PR #H327A000036

Group 1 sites receive more on-site training and follow up from ELiTeC staff than Group 2 sites, thereby providing a means to test conditions needed to establish and maintain ELiTeC. Group 1 sites' activities are modeled on the tasks identified during the initial research stage. Group 2 sites are modeled on an outreach replication model used successfully by the Center for 21 years. Group 3 sites are studied to determine (a) conditions necessary for maintenance and (b) modifications made by teachers. Both Groups 1 and 2 will receive continuous follow-up and support from the ELiTeC team because the literature and research phase demonstrated the need for a long-term support period. After collecting baseline data the first year, project staff offer follow-up support to Group 3 sites. Follow-up training and consultations occur on-site, by E-mail, phone, videotape exchange, web site discussion and review, and return visits to the ELiTeC project site. Contextual factors supporting effectiveness and sustainability of the system are being studied. Both qualitative and quantitative measures are used for evaluation.

The Steppingstones project is designed to investigate further the nature of effective administrative support for successful replication and to determine in which complex sites the model will work. The results from the study will be disseminated to a variety of target audiences and will be incorporated on the Center's web sites. Center staff will continue to develop materials and to incorporate current software and technology applications as they become available.

The Center staff will keep abreast of current literature and use it to refine the model. Further research into specific aspects of literacy, the differential effects of technology on children with disabilities, and related areas will continued to be studied.

Assurance Statement

A complete copy of this report has been sent to ERIC. Copies of the title page and abstract have been sent to NEC*TAS.

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